Energy Management Track

- Understanding Your Utility Bills
- Energy Tracking Systems
- Baseline & Benchmarking
- Break
- Energy Assessments
- Identifying Energy Opportunities
- Financing Energy Opportunities
- Open Discussion / Q&A

Understanding Your Utility Bills

Bob Miles, PE, CEM
Engineer

2009 Energy Management Workshops for Schools
February 24 & 26, 2009

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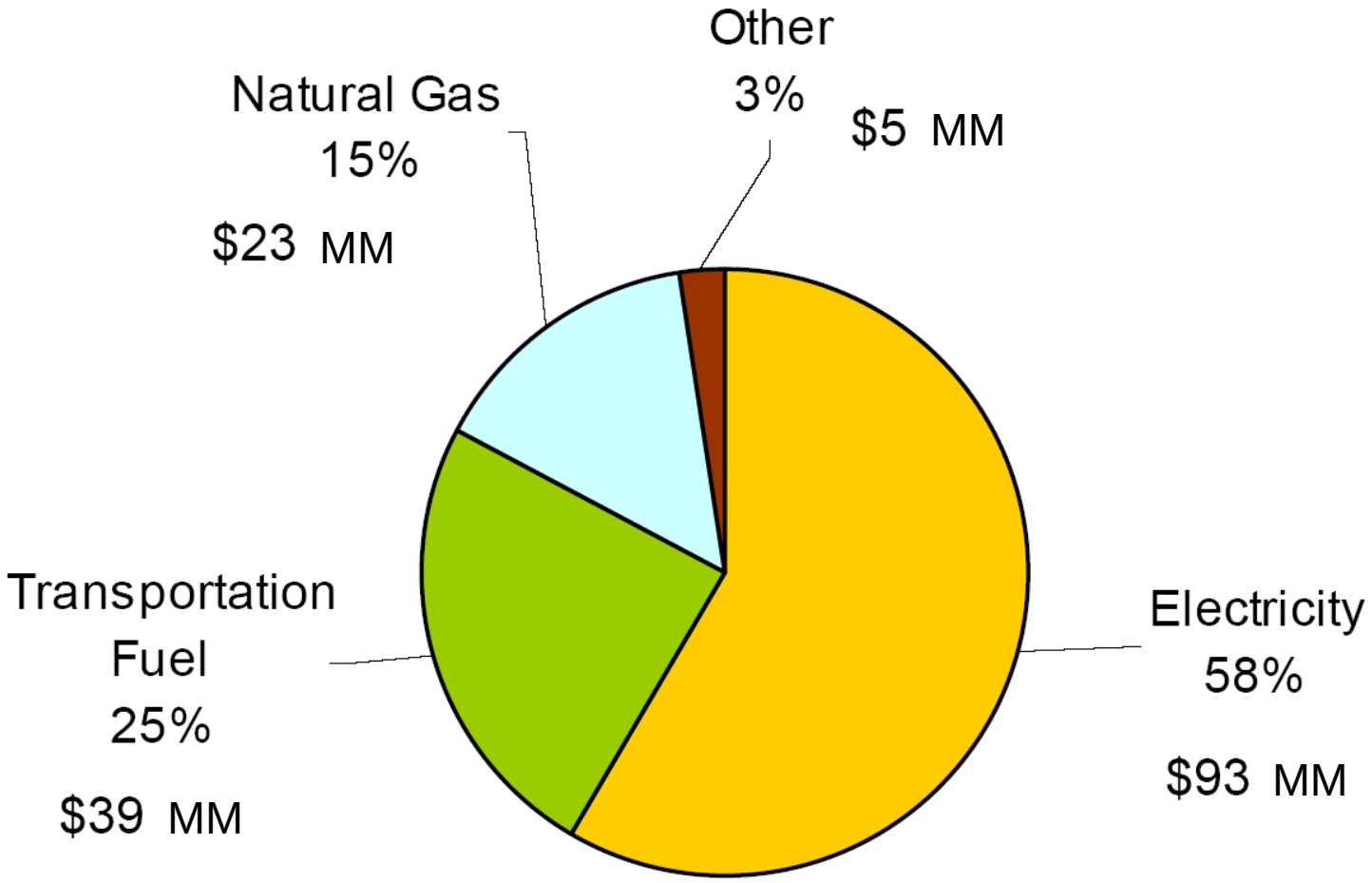
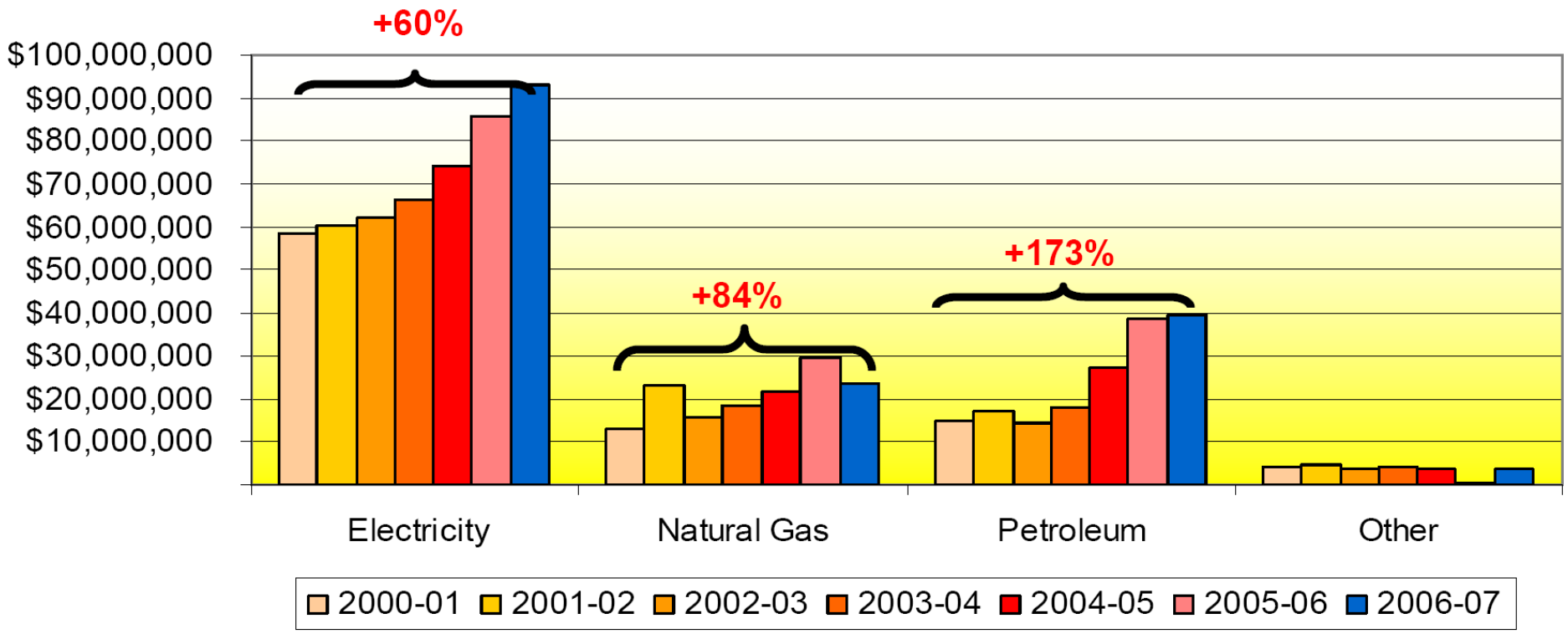
KY K-12 Public Schools Total Energy Expenditure by Type 2006-07



Source: KY Department for Energy Development and Independence

KY K-12 Public Schools Total Energy Expenditure by Energy Type and Percent Increase 2000-2006



Source: KY Department for Energy Development and Independence

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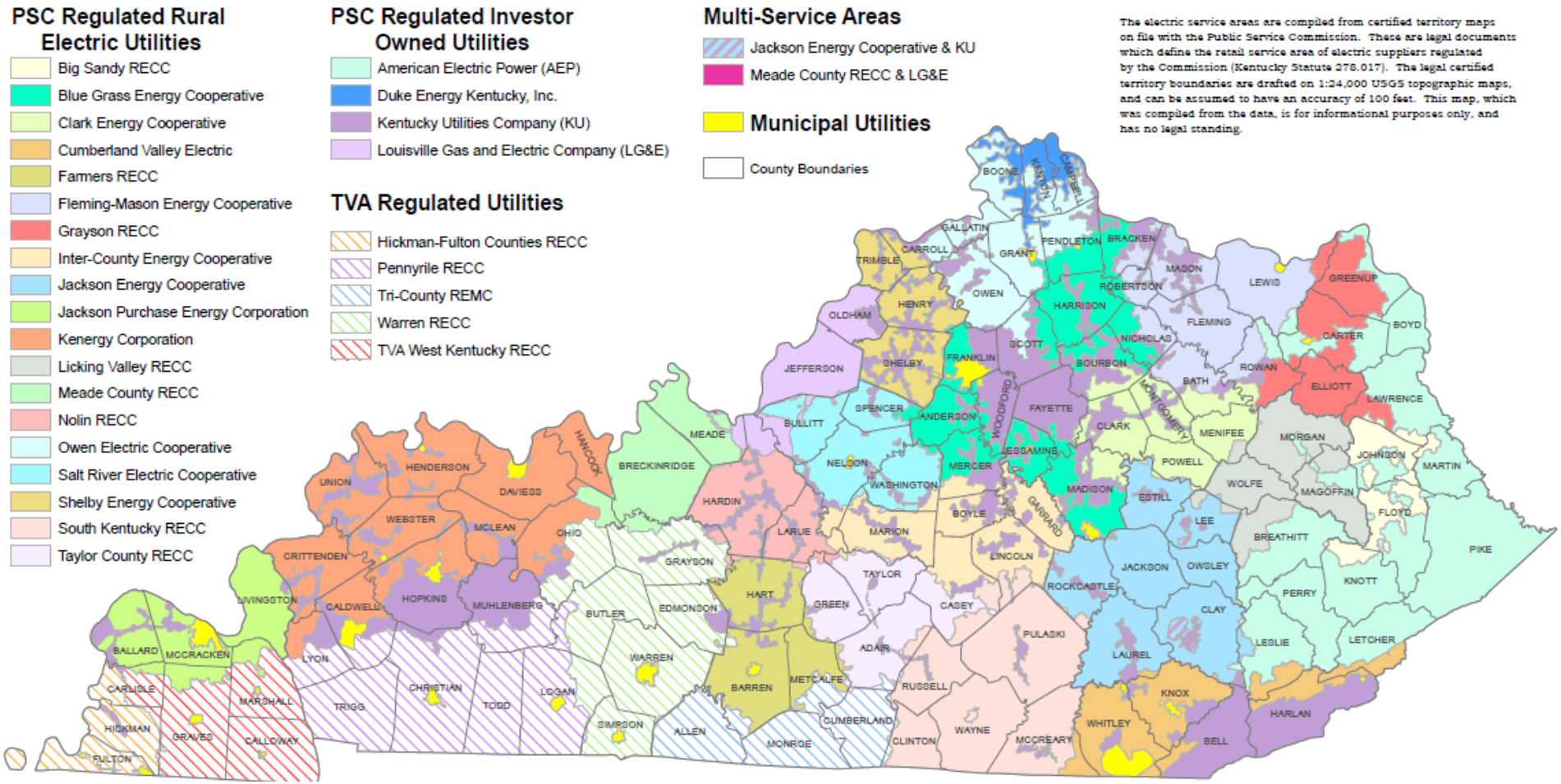
Energy Bill Analysis

Can't manage if you don't measure and monitor

- **Essential component of any energy management program**
  - ✓ **Continuing account of energy use and cost**
  - ✓ **Keeping up-to-date records of monthly energy consumption and associated costs**
  - ✓ **A separate record will be required for each type of energy used, i.e., gas, electric, oil, etc.**
  - ✓ **A single energy unit should be used to express the heating values of the various fuel sources (MMBtu)**

Electric Distribution Service Area



Source: KY Public Service Commission

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Energy Units – Electric Service

- kW = unit used to measure electrical demand (power)
  - ✓ Usually calculated in 15 or 30-minute intervals
  - ✓ Peak Demand = Greatest value in any 15 or 30-minute interval
    - Ex. 1,000 kWh/0.50 Hr = 2,000 kW Demand
- kWh = unit used to measure electrical energy
  - ✓ 1 kWh = 1,000 Watts of power used for 1 hour
  - ✓ 1 kWh = 3,412 Btu = 0.003412 MMBtu

Energy Units – Electricity Analogy

- **Electrical Charges typically have two metered components:**

1. **Demand (Power)**
2. **Consumption (Energy)**

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Walk-In Center Hours: Mon-Fri 8AM-5PM(EST)
Telephone Payments: (800) 807-3596
www.eon-us.com

DUE DATE	AMOUNT DUE
02/18/09	$14,145.25

See the Important Information section for details about your new rates.

ACCOUNT INFORMATION

Account Number:
Account Name:
Service Address:

ELECTRIC CHARGES

Rate Type: PS-SECONDARY PF ADJ

Customer Charge	75.00
Energy Charge	5,885.54
Demand Charge ($7.65 x 743.40 kw)	5,687.01
88.30% PF Adj to 90.00% ($7.65 x 14.3 kw)	109.40

Other Charges For Above Rates

Fuel Adjustment ($.00409 x 179328 kwh)	733.45
Program Cost Recovery ($.00006 x 179328 kwh)	10.76
Environmental Surcharge (6.500% x $12,501.16)	812.58
Merger Surcredit (1.013% CR x $13,313.74)	-134.87
Total Electric Charges	**$13,178.87**

Customer Service 1-800-383-5582

PLEASE RETURN THIS PORTION WITH YOUR PAYMENT

Account Number	Previous Balance	Payment Due Date	Total Amount Due	Winter Care Donation	Amount Enclosed
	$68.95	02/18/09	$14,145.25		$

Power Factor

- Low Power Factor (PF) Penalty
  - ✓ Typically caused by using magnetic devices such as light ballasts, motors, transformers…
  - ✓ Assessed when below 80% or 90%
- Three Effects of Low PF(<80%)
  - ✓ Robs Distribution System of Capacity
  - ✓ Higher Currents = High Voltage Drop & Electrical System Losses
  - ✓ Billing Penalty ($)
- Improvements:
  - ✓ Capacitors, High-PF Motors and Lighting Ballasts

Other Electric Charges

- Fuel Adjustment Charge – reflects fluctuations in the cost of fuel, or purchased power, used to supply that electricity
- DSM Cost Recovery – reflects costs in establishing and supporting a Demand Side Management Program
- Environmental Surcharge – reflects costs in establishing and maintaining environmental control of emissions from generating electricity

1320004900 Group 400488612

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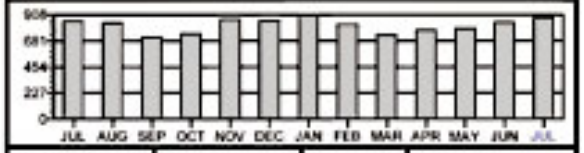
KILO WATT
1234 ELECTRIC BLVD
ELIZABETHTOWN KY 42701

SERVICE ADDRESS
ELECTRIC BLVD 1234

KWH USAGE HISTORY



Comparisons	Days of Service	KWH Used	Avg KWH per Day
Current Month	29	880	30
Last Month	32	840	26
One Year Ago	32	848	27

A MESSAGE FROM YOUR CO-OP

When paying your bill, write account number on check, and include bill stub. Please do not paperclip, staple or fold payment.

Please see reverse side for additional information.

Account Information		
Account Number		1234567890
Billing Cycle		01
Billing Date		08/02/2005
Meter Number		99999
Meter Reading	06/27/2005	12683
Meter Reading	07/26/2005	13563
KWH Usage		880
Meter Multiplier		1.0000
Demand Reading		0.000
Days Billed		29
Rate Schedule	1	RESIDENTIAL
Bill Type		R

Billing Information	$ Amount
BALANCE ON 07/01/2005	68.47
PAYMENT - THANK YOU	-68.47
KWH CHARGE	60.18
FUEL ADJUSTMENT 0.0012320	1.08
SCHOOL TAX	1.92
ENVIRONMENTAL SURCHARGE	2.62
CURRENT MONTH CHARGES	65.80

NET DUE UPON RECEIPT	65.80
GROSS AMOUNT DUE AFTER 5 PM ON 08/20/2005	68.99

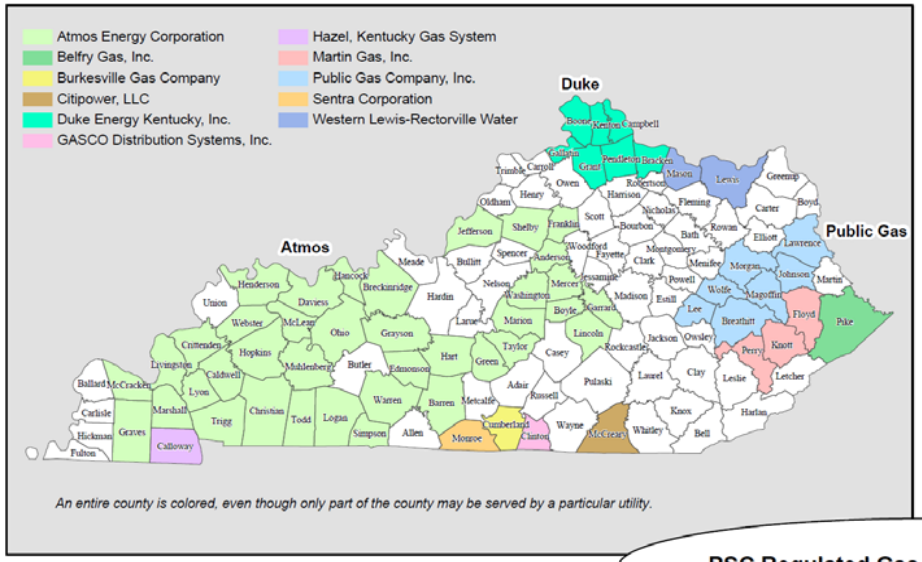
Energy Units – Natural Gas Service

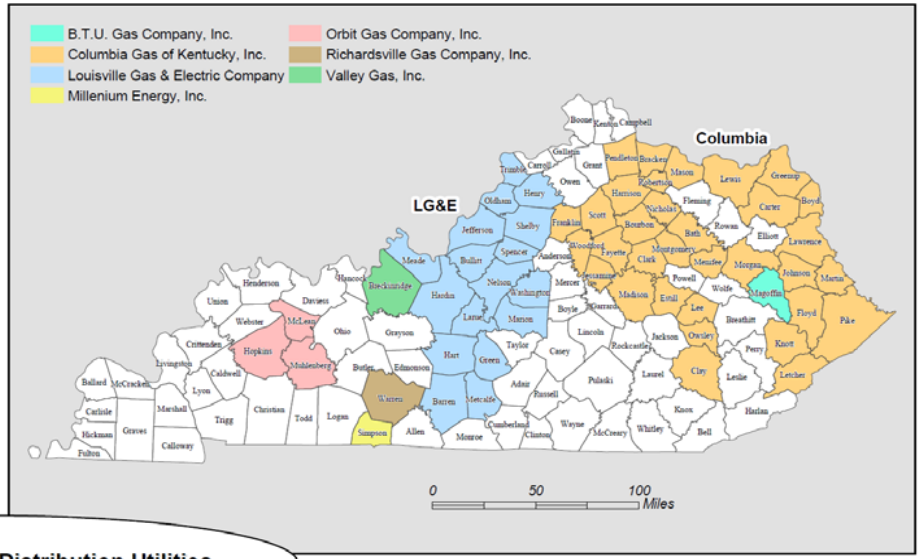
- CCF – One hundred cubic feet
- MCF – One thousand cubic feet
- MMBtu – million British thermal units
  - ✓ (ROT is 10 ccf per MMBtu)
- Dth – dekatherm (~10 ccf = 1 dth)

Natural Gas Service

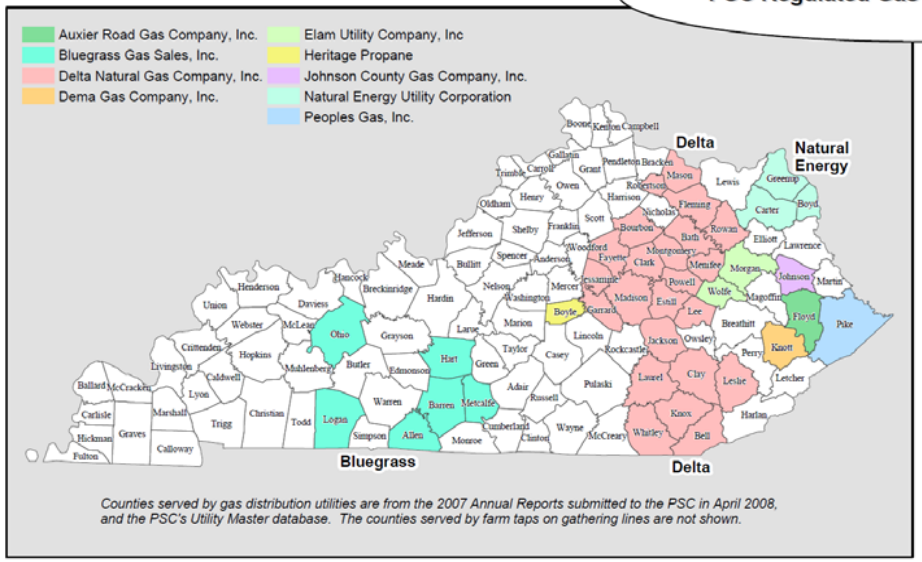
- **Natural Gas Charges typically have two metered components:**
  - ✓ **Supply/Purchase Adjustment – The cost to purchase natural gas from wholesalers.**
  - ✓ **Distribution/Transportation – The cost to deliver natural gas to the customer.**

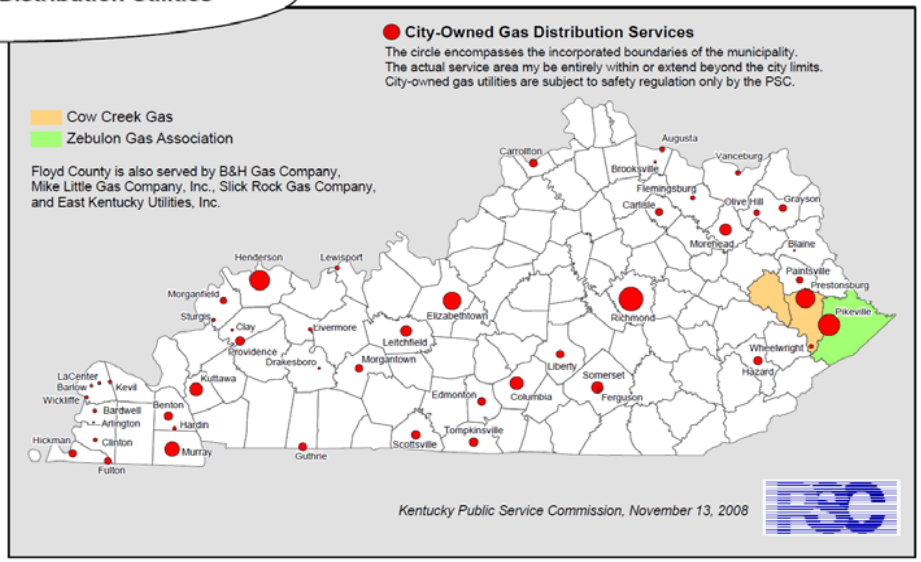
Natural Gas Distribution Utilities Service Areas

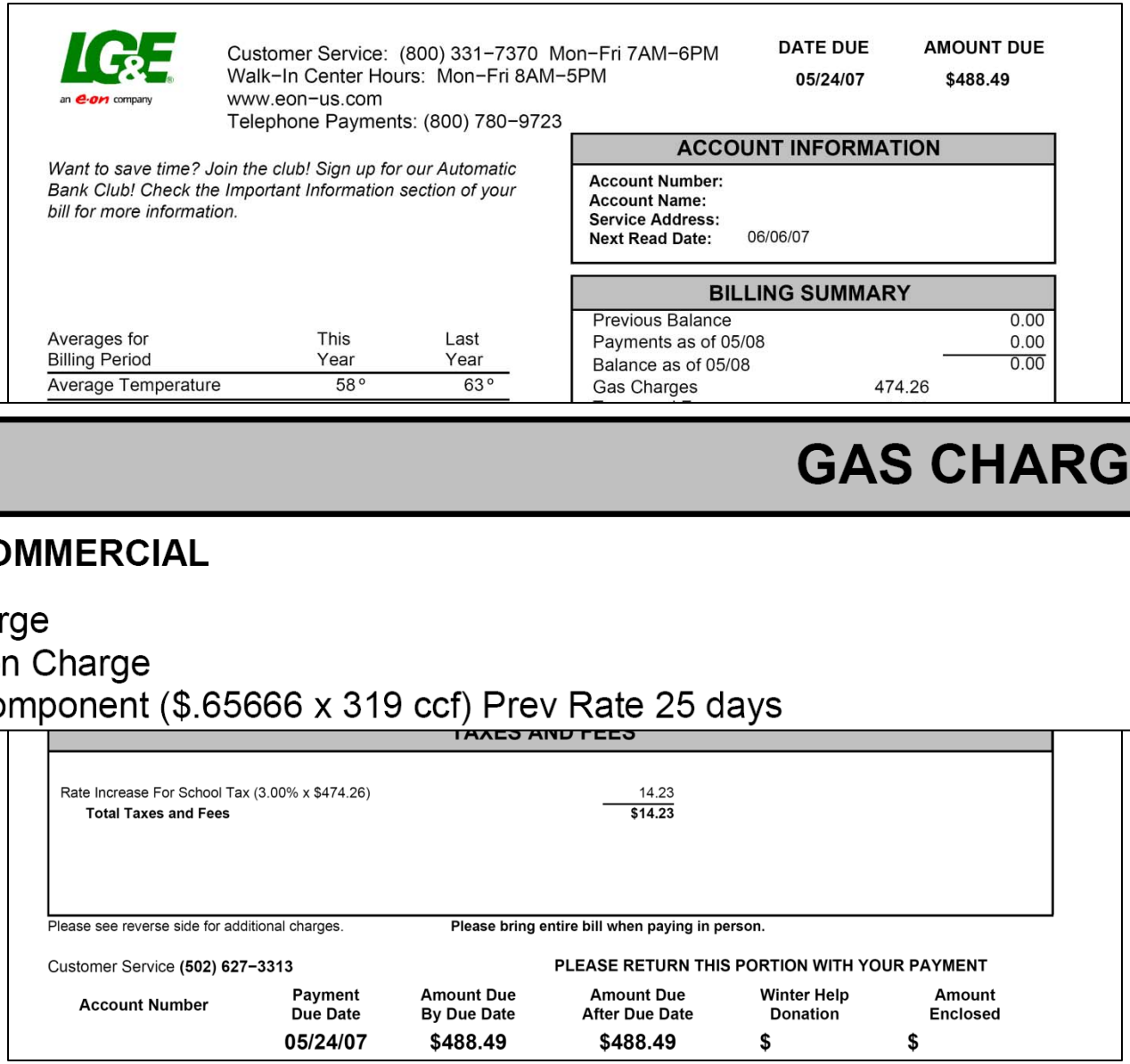




PSC Regulated Gas Distribution Utilities







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Telephone Payments: (800) 780-9723

DATE DUE	AMOUNT DUE
05/24/07	$488.49

Want to save time? Join the club! Sign up for our Automatic Bank Club! Check the Important Information section of your bill for more information.

ACCOUNT INFORMATION

Account Number:
Account Name:
Service Address:
Next Read Date: 06/06/07

BILLING SUMMARY

Previous Balance		0.00
Payments as of 05/08		0.00
Balance as of 05/08		0.00
Gas Charges	474.26	

Averages for Billing Period	This Year	Last Year
Average Temperature	58°	63°

GAS CHARGES

Rate Type: COMMERCIAL

Customer Charge	117.00
Gas Distribution Charge	61.07
Gas Supply Component ($.65666 x 319 ccf) Prev Rate 25 days	209.47

TAXES AND FEES

Rate Increase For School Tax (3.00% x $474.26)	14.23
Total Taxes and Fees	**$14.23**

Please see reverse side for additional charges. **Please bring entire bill when paying in person.**

Customer Service **(502) 627-3313**

PLEASE RETURN THIS PORTION WITH YOUR PAYMENT

Account Number	Payment Due Date	Amount Due By Due Date	Amount Due After Due Date	Winter Help Donation	Amount Enclosed
	05/24/07	$488.49	$488.49	$	$

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Billing and Rate Structure

- **Rate Analysis ("Tabletop" Assessment)**
  - ✓ **Utility companies classify electric and natural gas service according to Rate types**
    - **Potential Rate Examples: Residential; General Service; Commercial; Industrial**
  - ✓ **Riders modify the structure of a Rate and based upon specific qualifications of the customer**
    - **Potential Rider Examples: Interruptible; HLF (High Load Factor);TOD (Time-of-Day); Green Energy**
  - ✓ **Tariff Rates & Riders:**
    - **KY Public Service Commission (http://psc.ky.gov/tariffs/)**
    - **Utility Website**

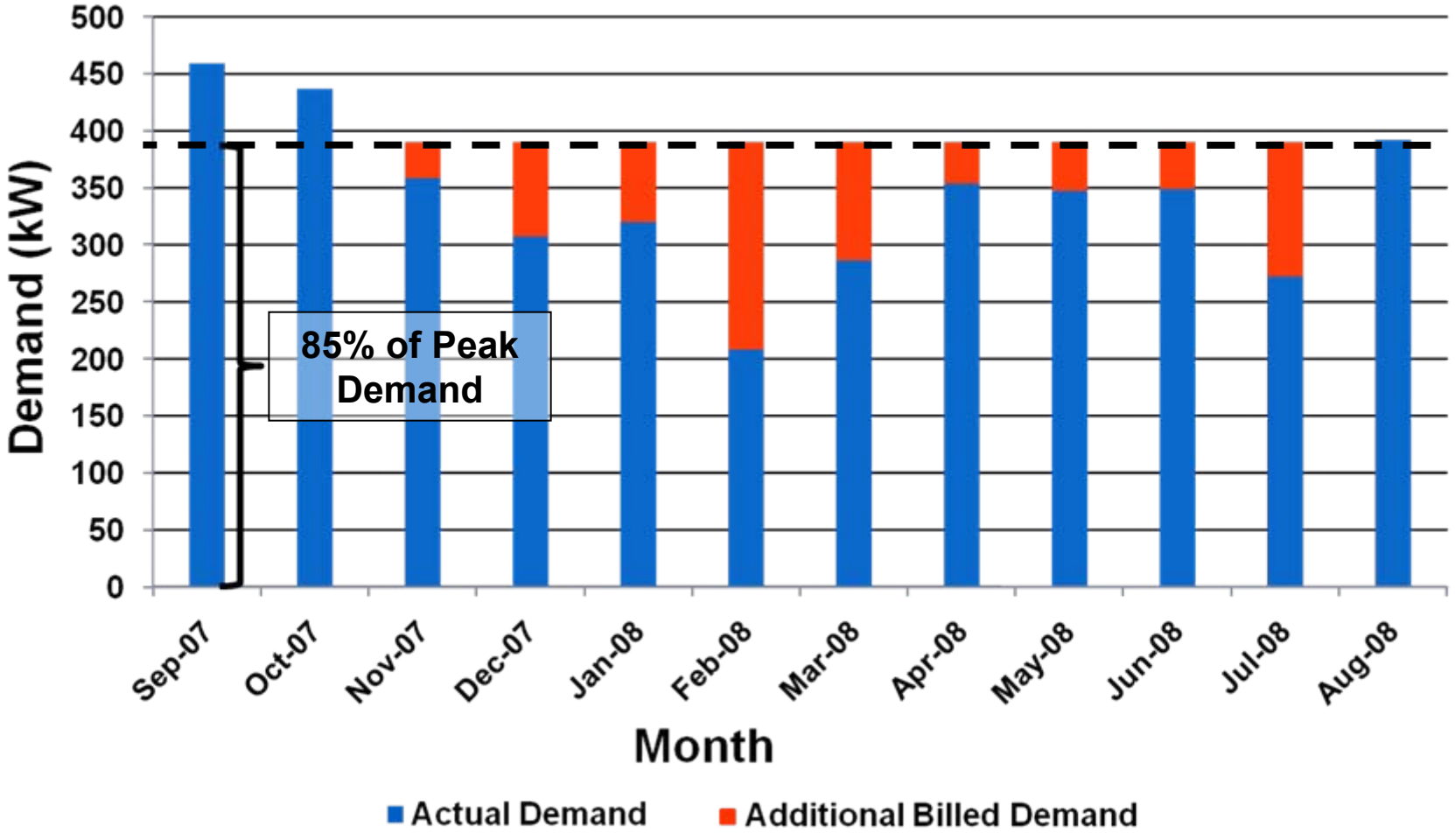
Billing and Rate Structure

- **Clauses:**
  - ✓ **Contract Demand – minimum monthly billing demand and excess demand charge**
  - ✓ **Demand Ratchet – billing mechanism that selects the highest demand from the current month or previous month(s)**
    - **Sometimes a percentage of the highest demand recorded in the previous 11 months is used.**

Billing and Rate Structure

- **Clauses (continued):**
  - ✓ **Minimum Energy Charge – typically based upon a contract demand.**
    - **Ex. Contract Demand 500 kW x 400 Hours = 200,000 kWh**
    - **200,000 kWh x Energy Price (~$0.06 kWh) = $12,000**
  - ✓ **Time of Day**
    - **Establishes a daily time period in which the peak demand is measured**
    - **Can also be used to establish peak and non-peak energy usage charge (Time of Use)**

Ratchet Clause Example



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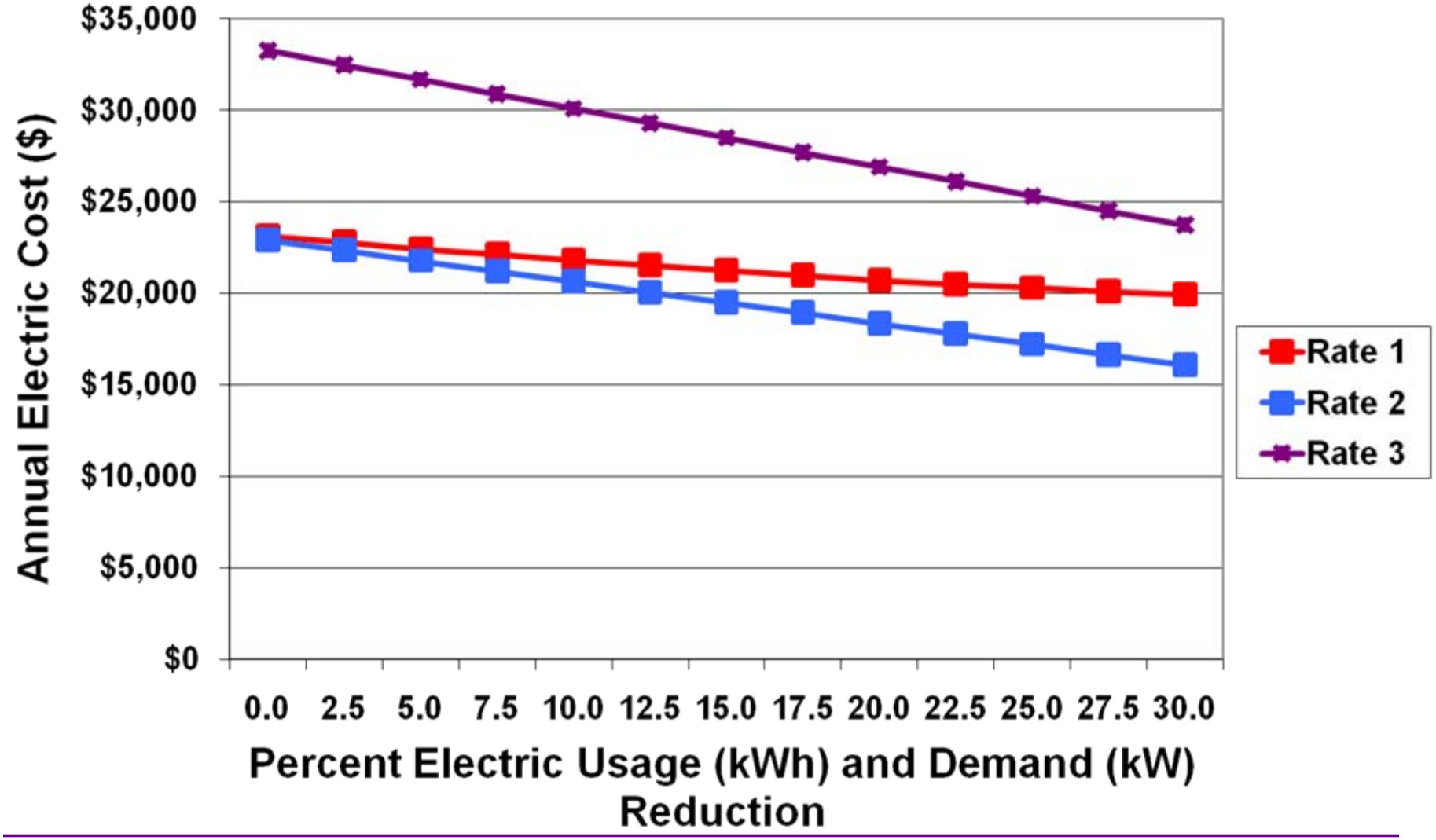
Billing and Rate Structure

- Understand what rate(s) your school or school district is on and how the rate works
- Review utility contract(s)
- Discuss rate contract(s) and rate options with your Utility Account Representative
- Keep future plans in mind when discussing rate and contract options

Sensitivity Analysis



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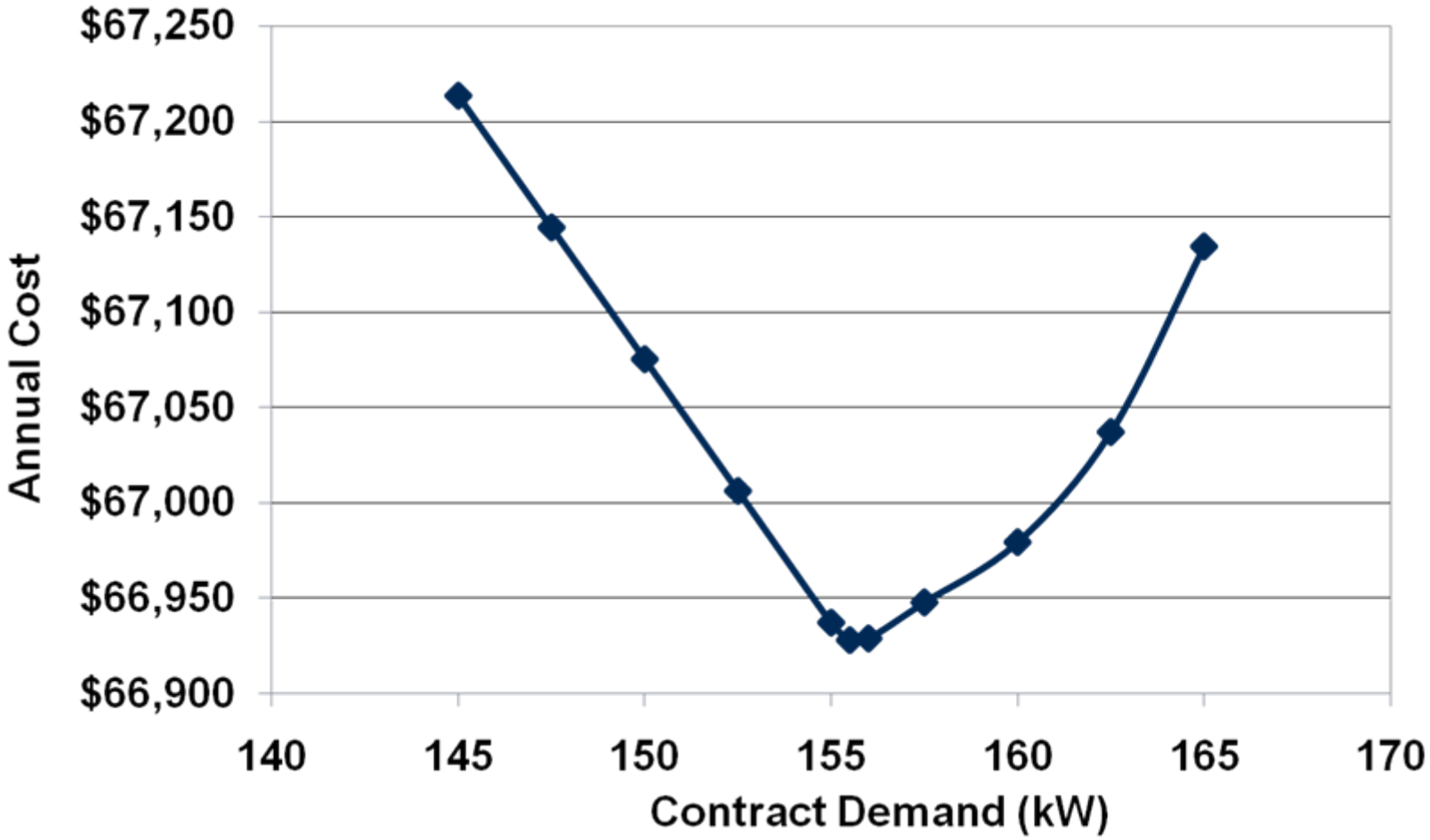
Contract Demand Optimization



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Billing and Rate Structure

"As a result of your analysis, ICS did switch to a more economical electrical rate structure that will save us over $11,000 per year. The Vice President of Operations was able to get a rebate in excess of $13,000 …"

Energy Tracking Systems

Bob Miles, PE, CEM
Engineer

2009 Energy Management Workshops for Schools
February 24 & 26, 2009

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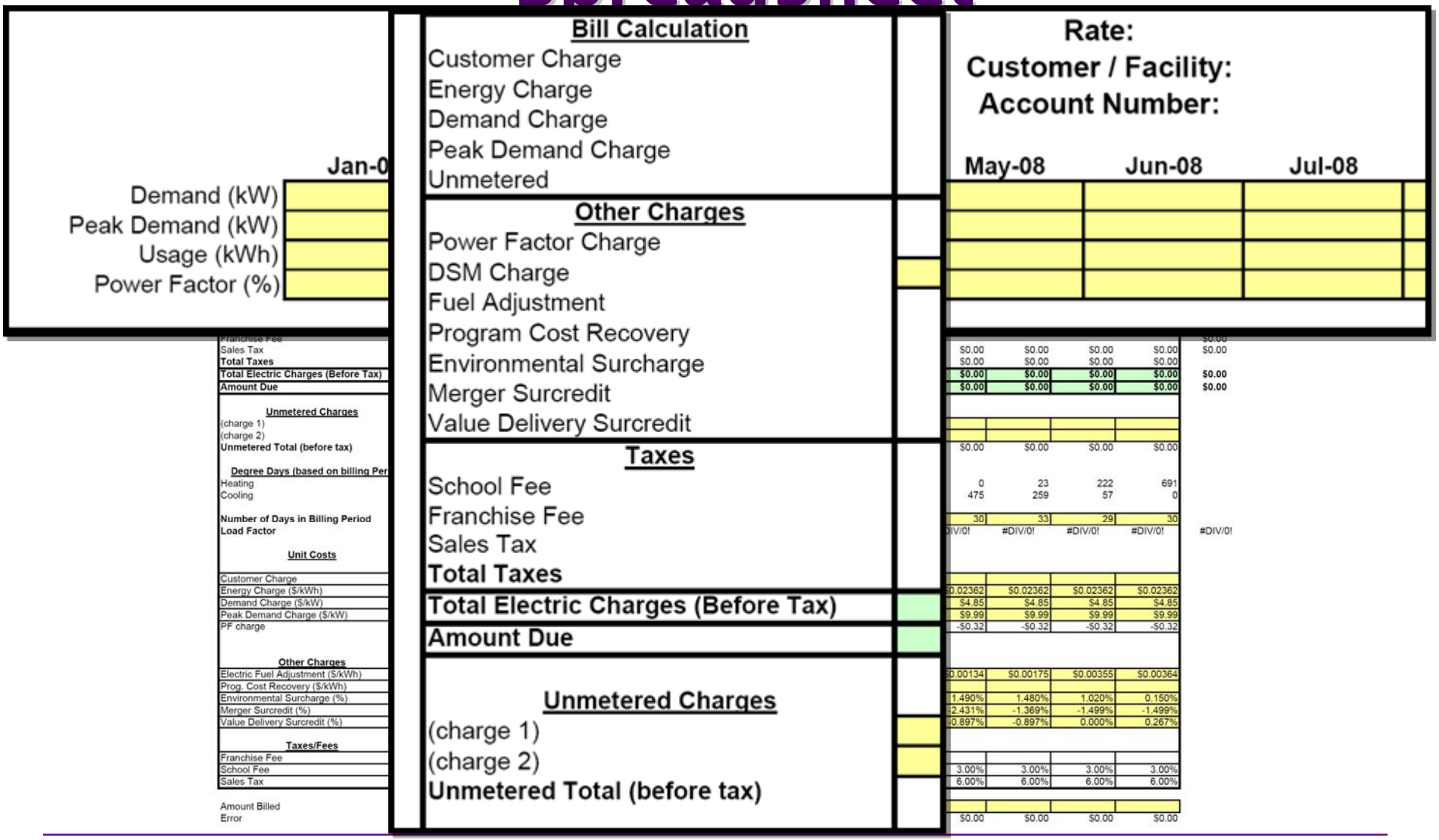
Energy Bill Analysis Leads Where?

- Trends and irregularities in energy usage and costs can be detected
- Track Energy Use, Demand and Cost
- Common Tools:
  - ✓ Spreadsheets
  - ✓ Energy Star Portfolio Manager
  - ✓ Utility Websites
  - ✓ Energy Service Provider/Energy Service Company (ESCO)($)
    - Web-based utility tracking & reporting services
    - Real time energy tracking services

Energy Tracking Systems Comparison

Tool	Data Entry	Custom Functions	User Friendly	Software Cost	Overall Rating
Spreadsheet	Manual	Yes	No	Usually Free	Good for DIY's
Energy Star Portfolio Manager	Manual /Auto	Some	Yes	Free	Good for overview and basic tracking
Energy Service Provider/Company	Auto	Yes	Yes	Initial Set Up and Annual Service Fee	Good for large school districts

Spreadsheet



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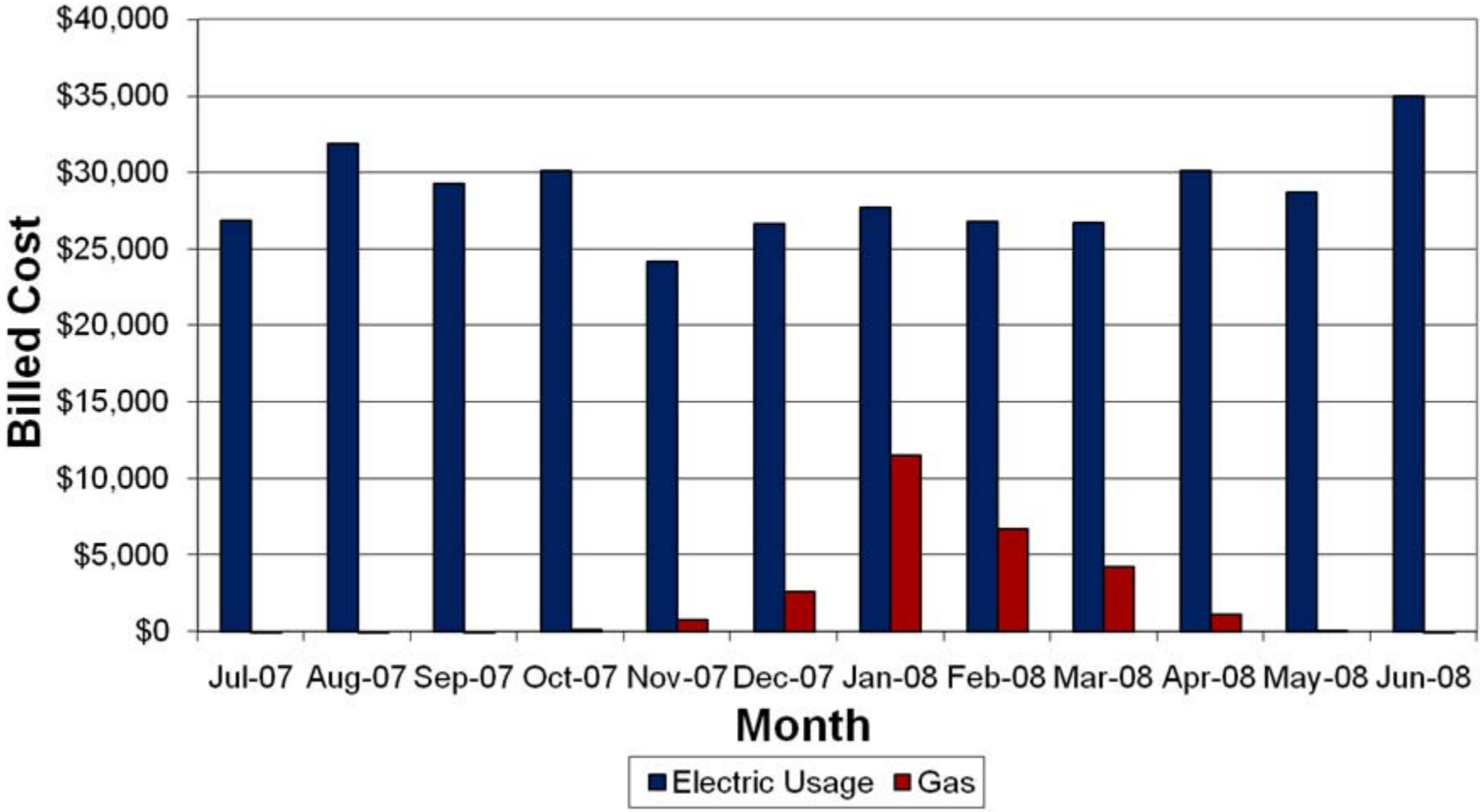
Spreadsheet – Energy Costs



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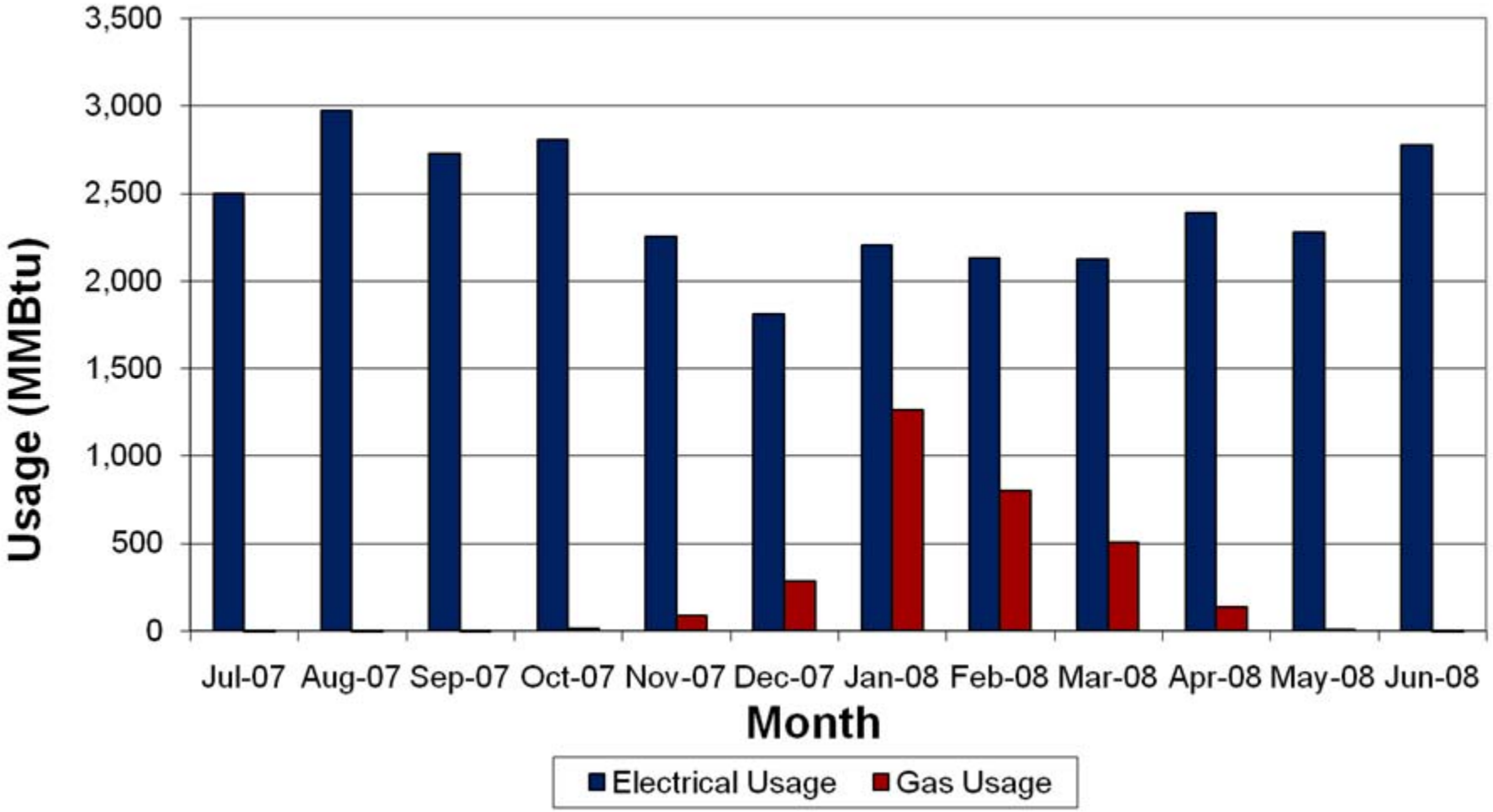
Spreadsheet – Energy Usage



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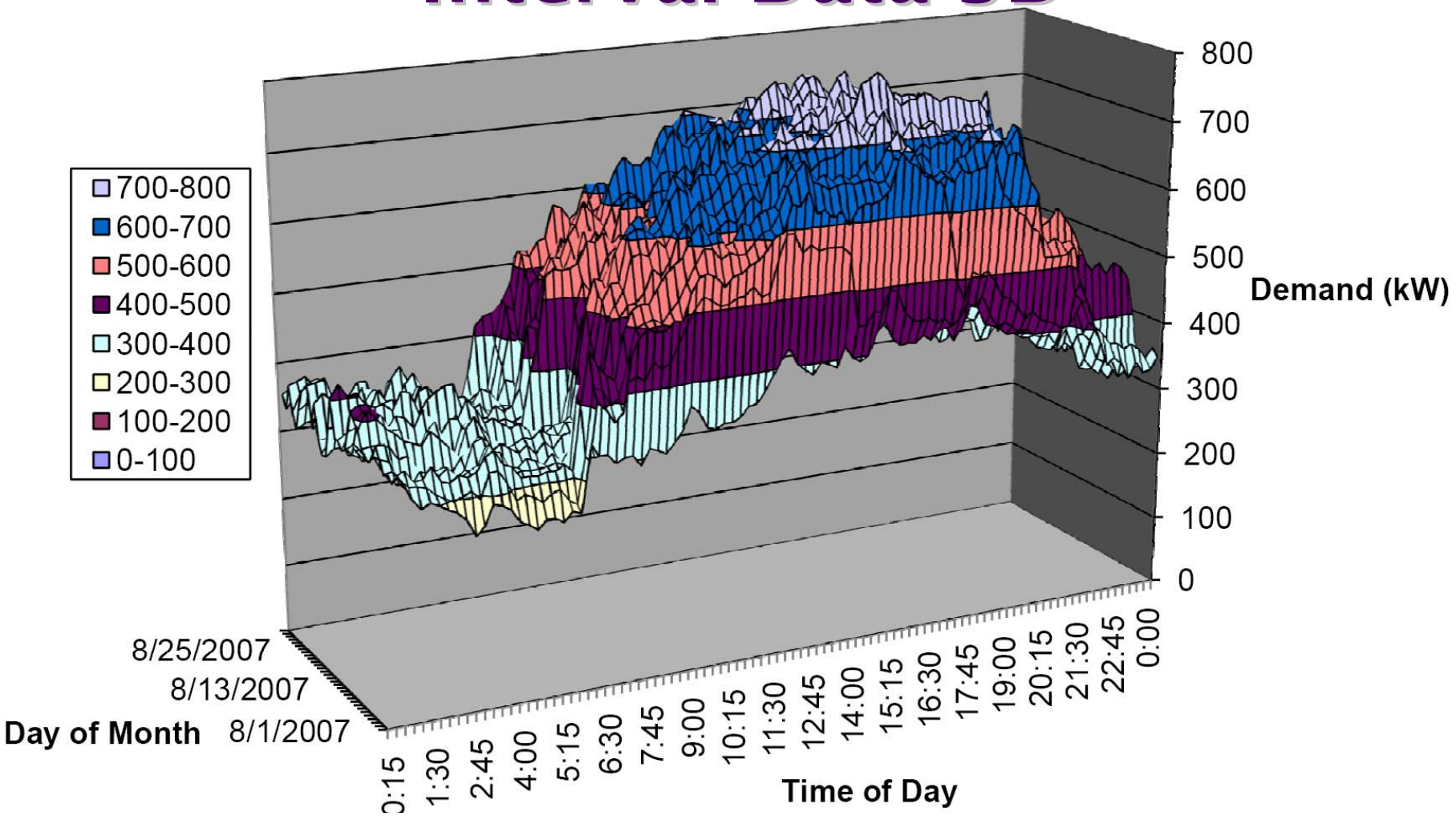
Spreadsheet – Demand Interval Data

- Customers that are metered for demand in 15, 30 – minute intervals can request this data from the utility
- Useful for tracking and determining load shifting/shedding opportunities
- Common tools like spreadsheets can be used for this analysis

Spreadsheet – Monthly Demand Interval Data 3D



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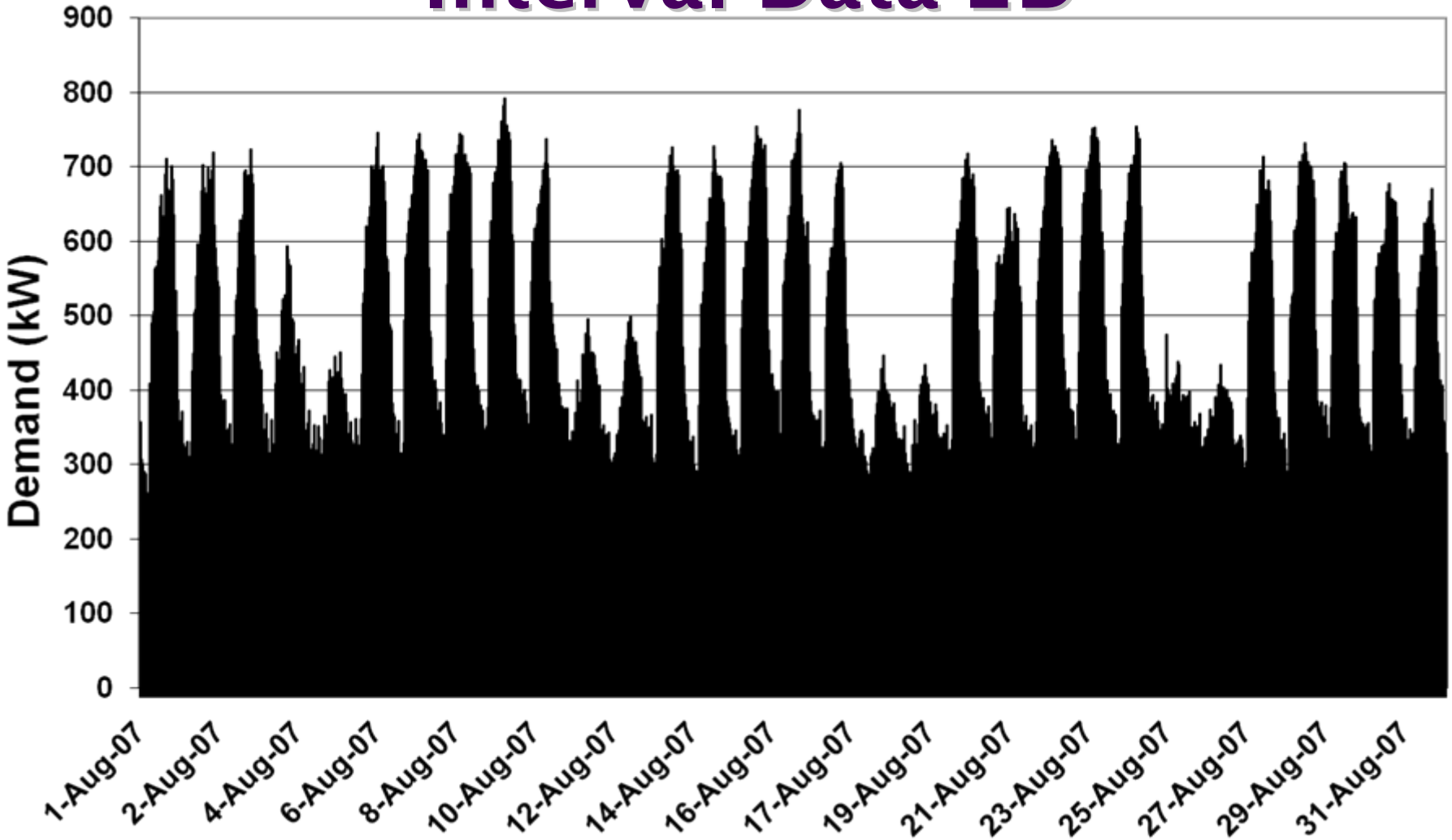
Spreadsheet – Monthly Demand Interval Data 2D



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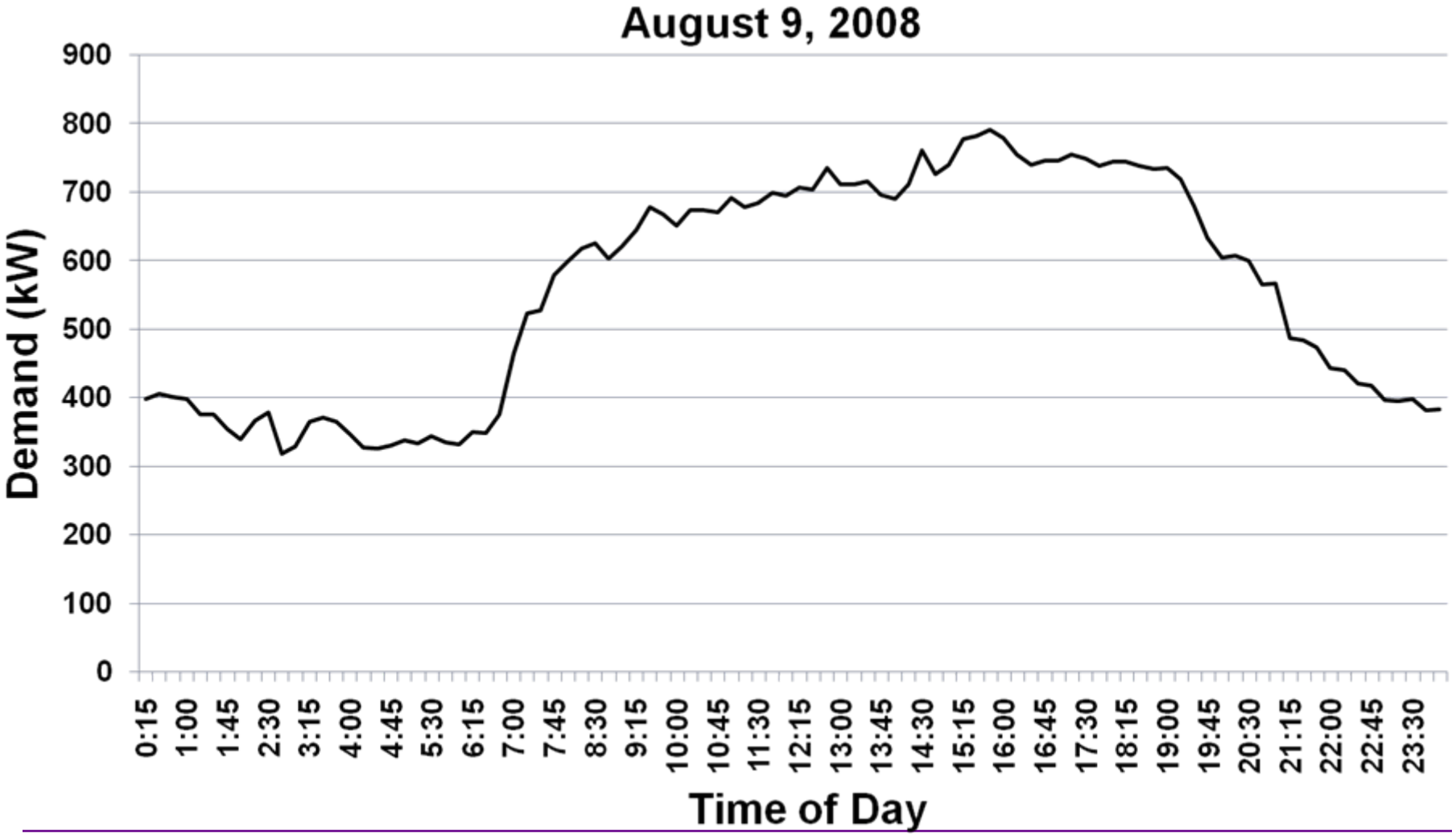
Spreadsheet – Daily Demand Interval Data



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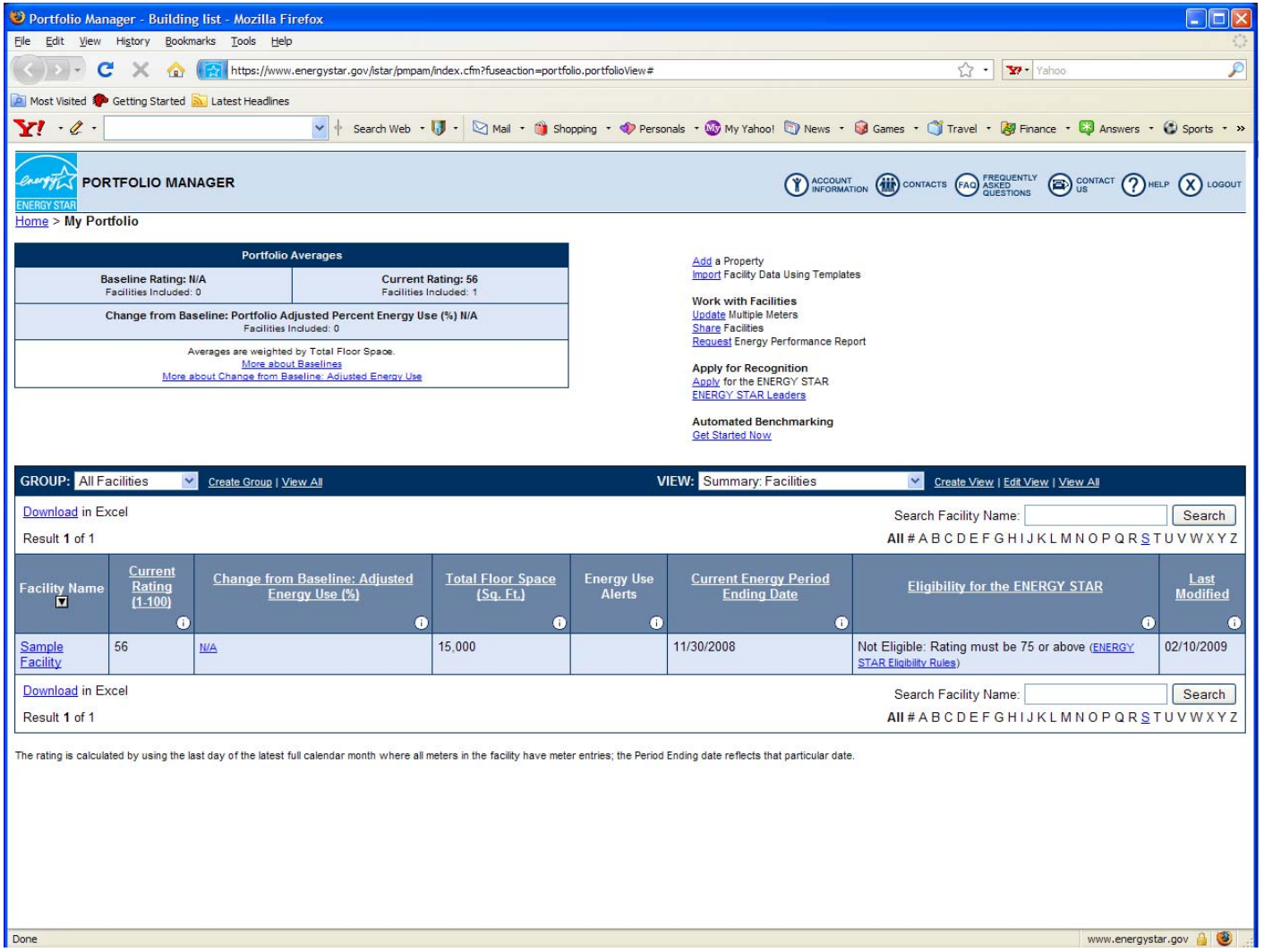
Load Factor

- Load Factor = Avg. Demand/Peak Demand
  - ✓ A high load factor indicates a relatively constant load and less potential for demand improvement
    - Ex. 100,000 kWh / (500 Operating Hours/mo) = 200 kW Avg
    - 200 kW Avg / 250 kW Peak Demand = 80% Load Factor
  - ✓ Elementary, middle and high school clients had load factors ranging from 40% to 50%
  - ✓ Can be improved by establishing a Demand Management Program

Energy Star Portfolio Manager

- Available at https://www.energystar.gov/istar/pmpam/
- Allows users to:
  - ✓ Track multiple energy and water meters for each facility
  - ✓ Baseline and Benchmark your facilities
  - ✓ Share building data with others inside or outside your organization
  - ✓ Enter operating characteristics, tailored to each space use category within your building
  - ✓ Apply for Energy Star Label (Rating 75 or above)

Energy Star Portfolio Manager



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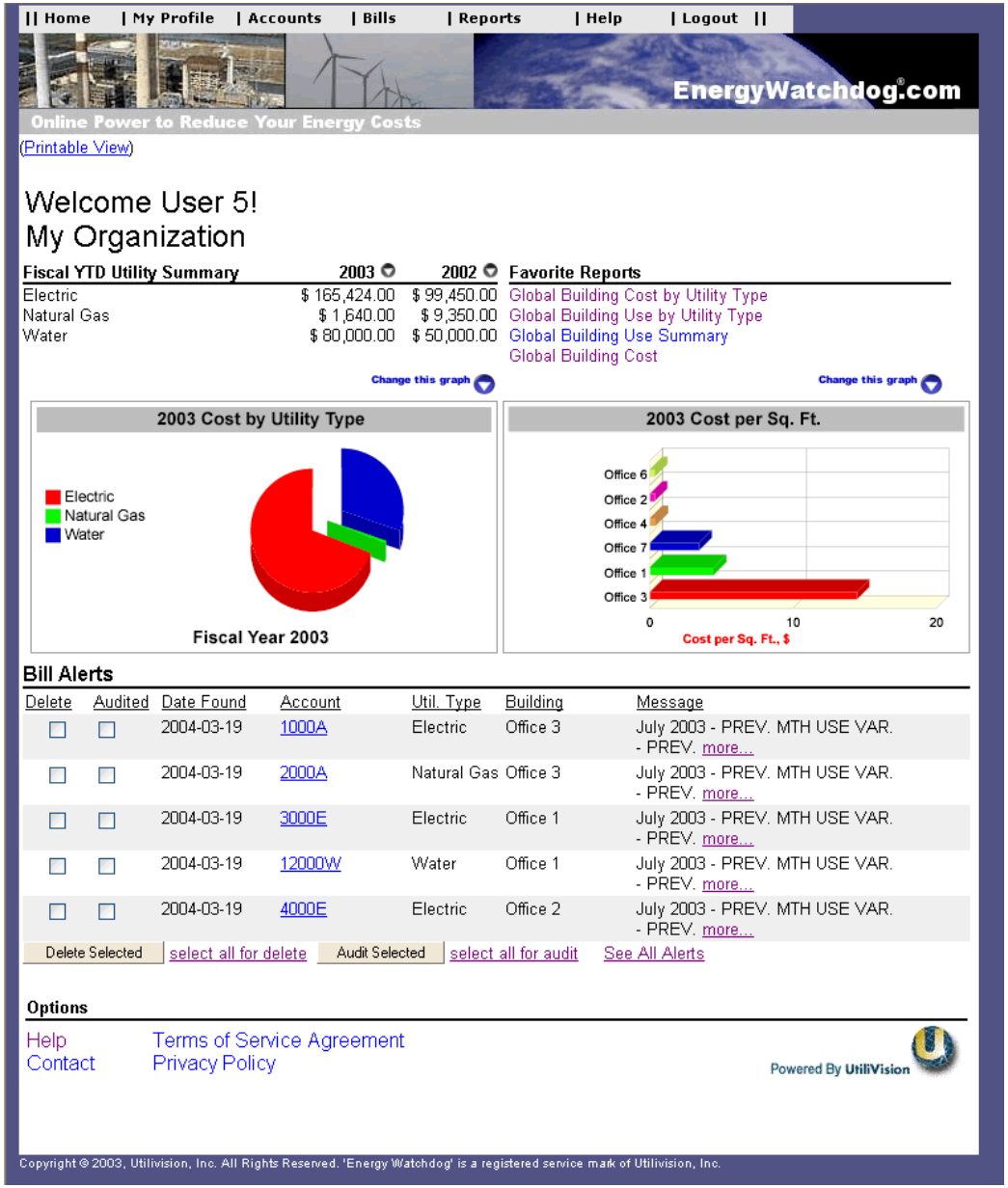
Energy Star Portfolio Manager

- **Data Import:**
  - ✓ Manual entry into website
  - ✓ Import from spreadsheet template (10 or more facilities)
  - ✓ Automated download from Energy Service Provider (Ex. Siemens, Energy Watchdog, etc)
- **Data Export**
  - ✓ Download facility/meter data to spreadsheet
  - ✓ Statement of Energy Performance Reports

Energy Service Provider/Company

- **Numerous Tracking Services Available:**
  - ✓ **Energy Watchdog Pro**
  - ✓ **SchoolDude**
  - ✓ **Advantage IQ**
  - ✓ **LPB Energy Management**
  - ✓ **New Energy Technology**
  - ✓ **Many More……**


|| Home | My Profile | Accounts | Bills | Reports | Help | Logout ||
EnergyWatchdog.com
Online Power to Reduce Your Energy Costs
(Printable View)
Welcome User 5!
My Organization
Fiscal YTD Utility Summary 2003 2002
Electric $ 165,424.00 $ 99,450.00
Natural Gas $ 1,640.00 $ 9,350.00
Water $ 80,000.00 $ 50,000.00
Favorite Reports
Global Building Cost by Utility Type
Global Building Use by Utility Type
Global Building Use Summary
Global Building Cost
Change this graph
Change this graph
2003 Cost by Utility Type
Electric
Natural Gas
Water
Fiscal Year 2003
2003 Cost per Sq. Ft.
Office 6
Office 2
Office 4
Office 7
Office 1
Office 3
0
10
20
Cost per Sq. Ft., $
Bill Alerts
Delete Audited Date Found Account Util. Type Building Message
2004-03-19 1000A Electric Office 3 July 2003 - PREV. MTH USE VAR. - PREV. more...
2004-03-19 2000A Natural Gas Office 3 July 2003 - PREV. MTH USE VAR. - PREV. more...
2004-03-19 3000E Electric Office 1 July 2003 - PREV. MTH USE VAR. - PREV. more...
2004-03-19 12000W Water Office 1 July 2003 - PREV. MTH USE VAR. - PREV. more...
2004-03-19 4000E Electric Office 2 July 2003 - PREV. MTH USE VAR. - PREV. more...
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select all for delete
Audit Selected
select all for audit
See All Alerts
Options
Help
Contact
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Energy Service Provider/Company

- Items to consider:
  - ✓ Accessibility: Internet/Software, User Levels
  - ✓ Reporting Abilities: Customizable
  - ✓ Data/Bill Verification
  - ✓ Size Limitation
  - ✓ Sub-Metering
  - ✓ Normalizing Capabilities
  - ✓ Expense: Setup, Monthly Data Entry Fee, Annual Service Fees

Baseline and Benchmarking

Bob Miles, PE, CEM
Engineer

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What is Baseline and Benchmarking?

- **Baseline – Initial collection of data which serves as a basis for comparison with subsequently acquired data**

- **Benchmarking – Measurement and comparison of the facility's own energy use over time (internal) or a comparison to similar facilities outside the organization (external)**

Why Baseline and Benchmark?

- "If you can't measure it, you can't manage it"
- Increase awareness
- Creates accountability
- Provides feedback
- Helps identify opportunities

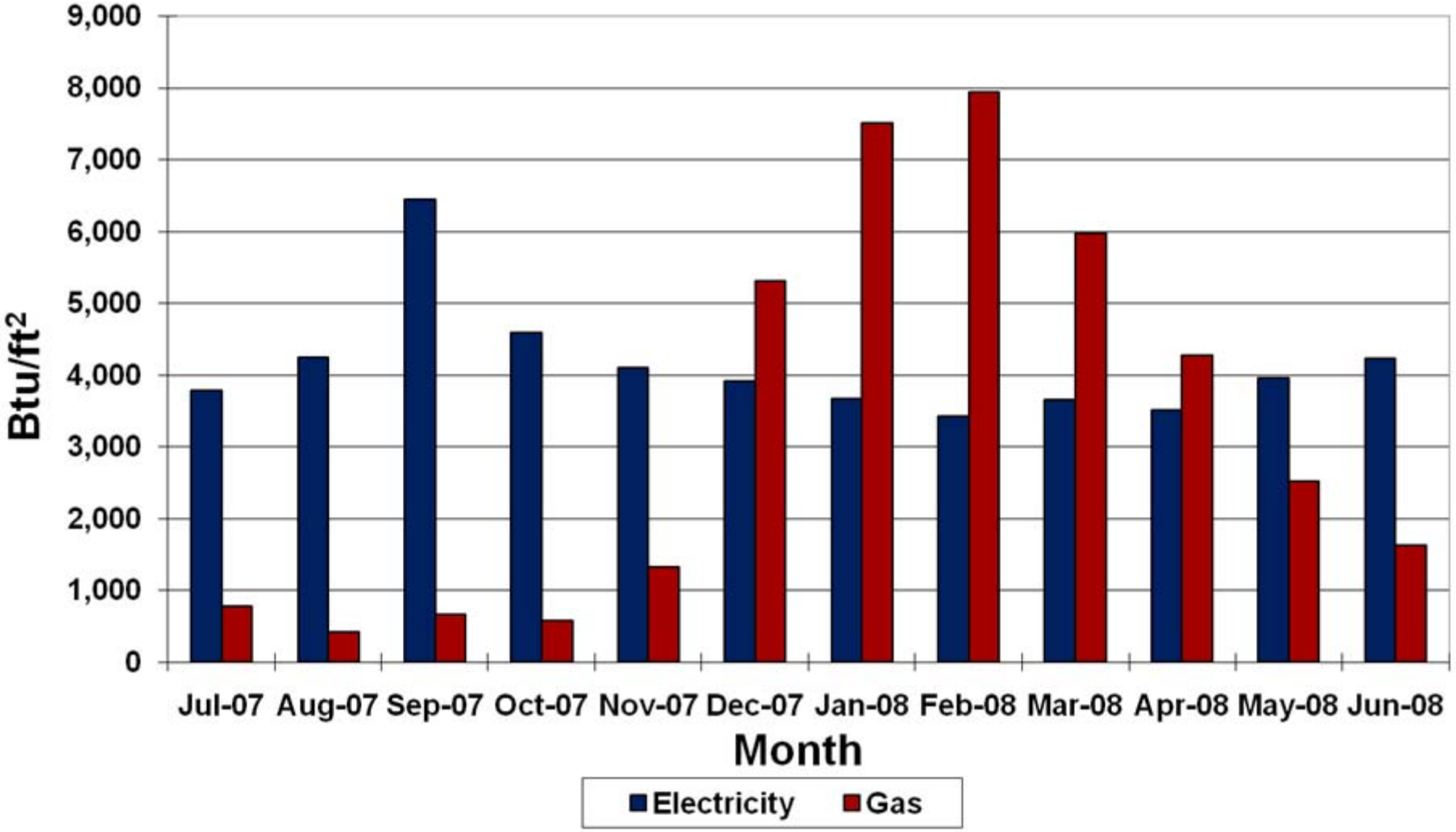
Basic Energy Accounting

- **Normalizing - process of removing the impact of factors on energy use to fairly compare the energy performance of facilities and operations**
- **School's energy usage/ cost can be normalized using:**
  - ✓ **Building Size (ft^2 of heated/cooled space)**
  - ✓ **Temperature (HDD and CDD)**
  - ✓ **Operation Hours**
  - ✓ **Number of Students**

Standard Measures

- Energy Use Index (EUI) – kBtu/ft^2/year
  - ✓ National average for school buildings is 73 kBtu/ft^2/year
  - ✓ Kentucky schools average is 76 kBtu/ft^2/year
- Energy Cost Index (ECI) – $/ft^2/year
  - ✓ OK to use within a school district
  - ✓ Since cost of energy varies with utility/location, probably not a good index to compare with other school districts

Normalize and Baseline



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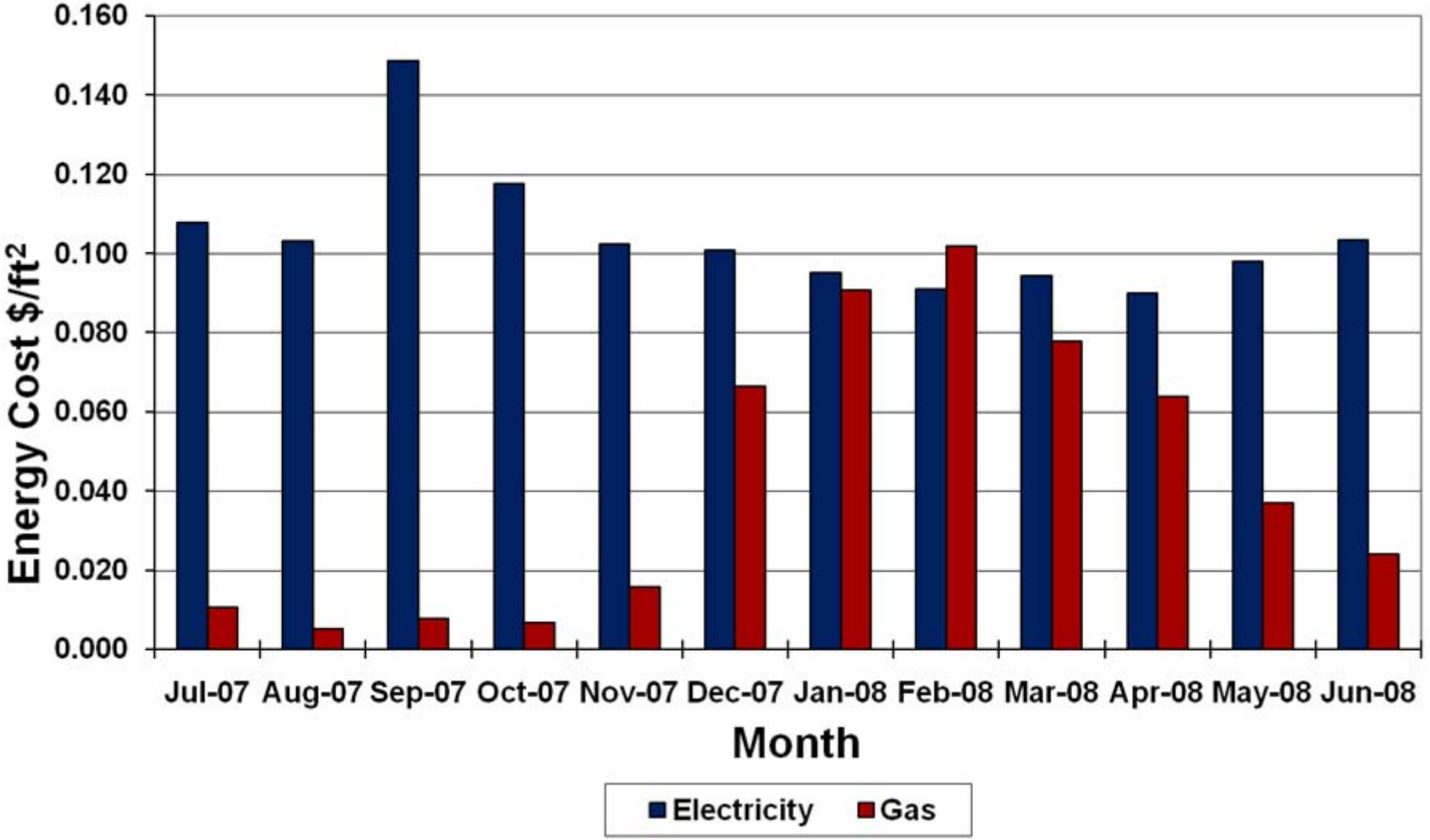
Normalize and Baseline



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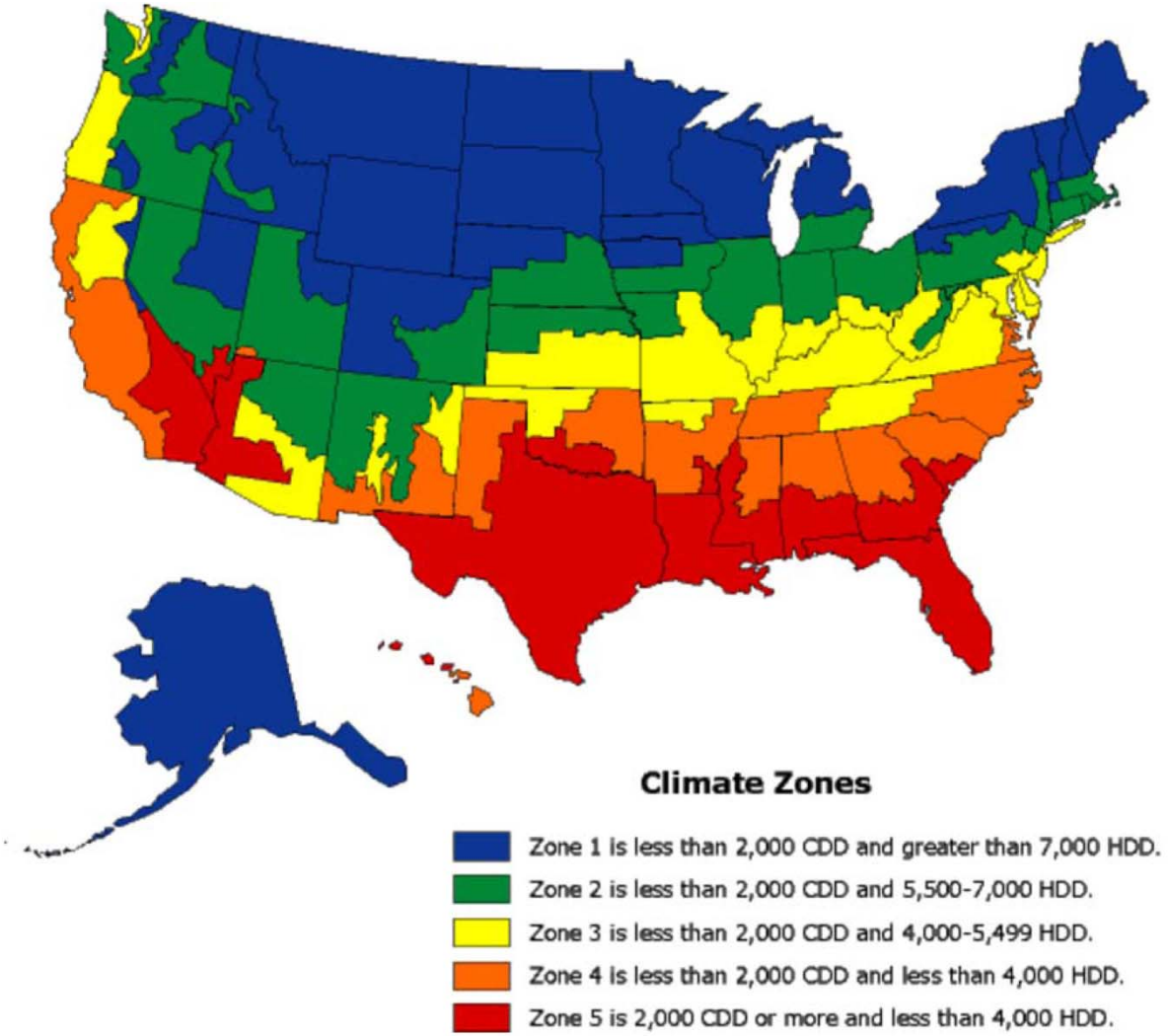
Weather Normalization

- Accounting for outdoor temperature variation
- Degree Day – Summation of individual deviations of outdoor temperature from a base indoor temperature
  - ✓ A base indoor temperature of 65°F is typically used
  - ✓ 1 Heating Degree Day (HDD) = 1 Degree below 65°F for one day
  - ✓ 1 Cooling Degree Day (CDD) = 1 Degree above 65°F for one day

Weather Normalization



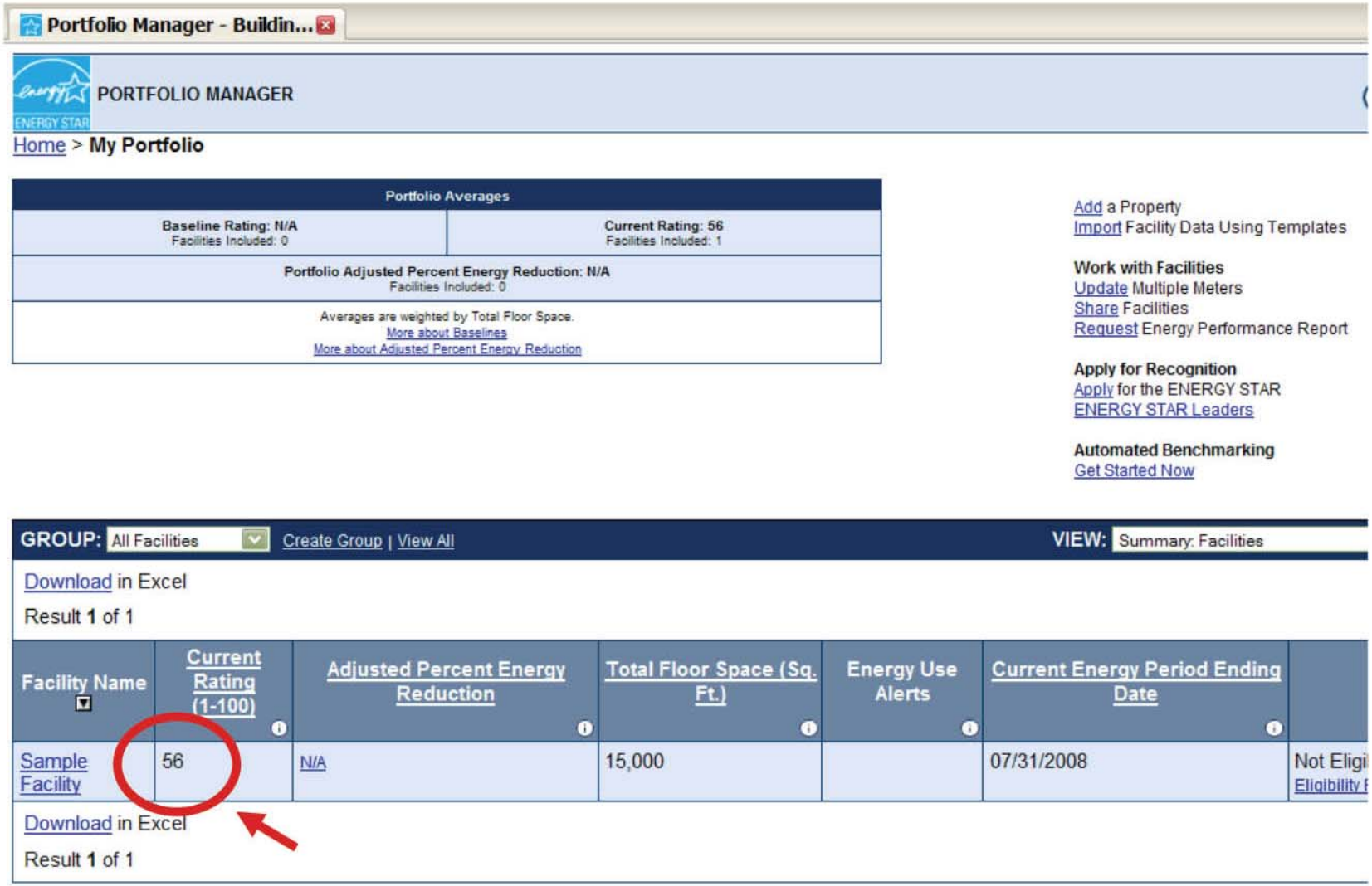
Weather Normalization

- Good for a general inspection of energy use with regards to outdoor temperature
- Portfolio Energy Manager includes weather normalization factors in the Source Energy Intensity (kBtu/ft^2) Rating
- Degree Data is available at:
  - ✓ NOAA website: http://www.weather.gov/
  - ✓ www.degreedays.net

Portfolio Manager

- Benchmarking Your School
- Four Easy Steps
  - ✓ Go to www.energystar.gov and register for a Portfolio Manager Account
  - ✓ Add a "property" (your school)
  - ✓ Add a "space" (your school space attributes)
  - ✓ Enter at least 12 months of energy use data
- Portfolio Manager can provide:
  - ✓ Rating (1 to 100) that compares your school with a national average (50)
  - ✓ EUI (kBtu/ft2/year) for each facility

Portfolio Manager



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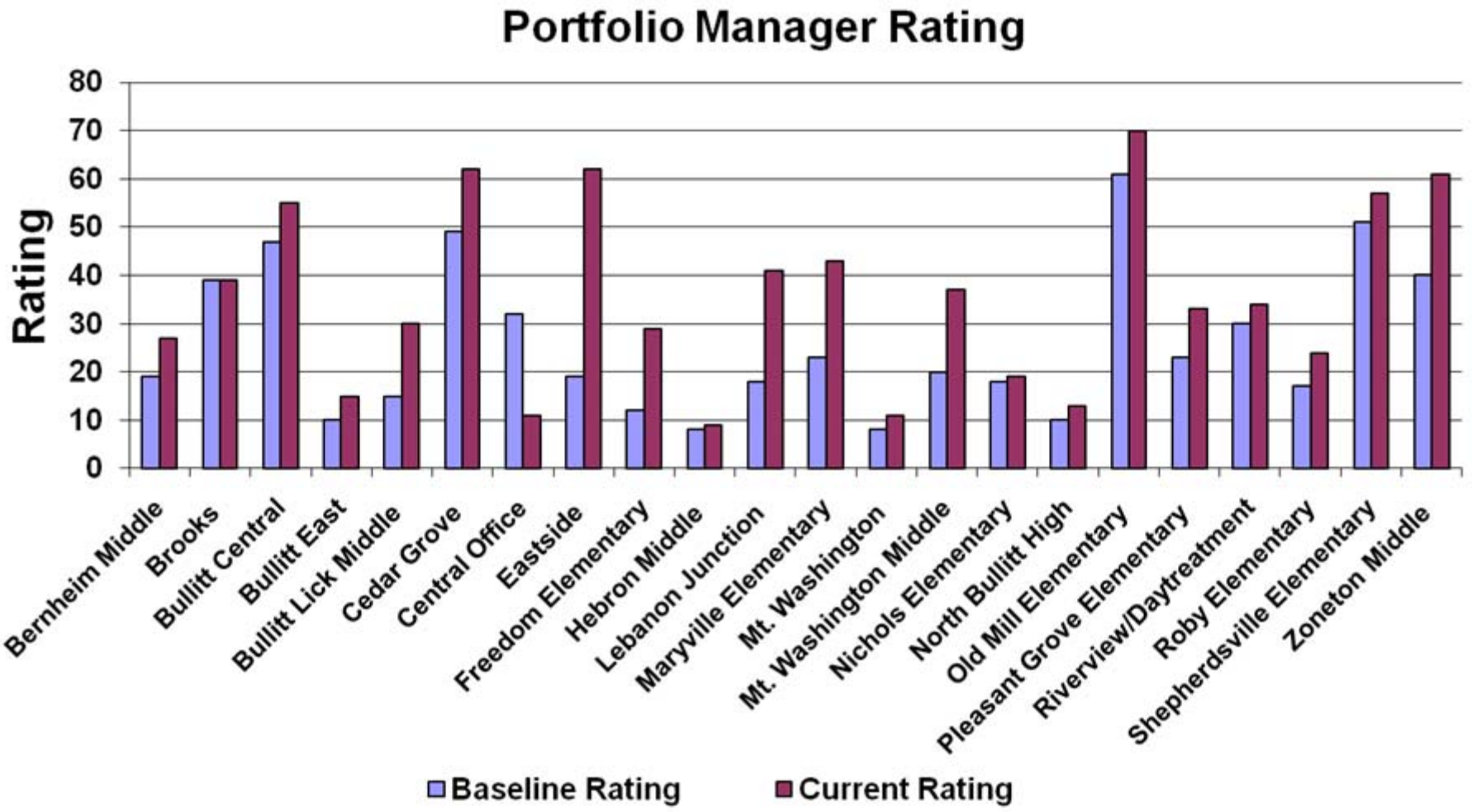
KEEPS

Bullitt County Benchmarking



Energy Assessments

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Program Manager - Tech Services

2009 Energy Management Workshops for Schools
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Where Does the Energy Go?

Lights?

Kitchen?

Hot Water?

Computers?

AC?

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Primary Concerns

- Bottom Line
  - ✓ Cost Savings
  - ✓ Energy Savings
- Improved educational setting
- Comfort of building occupants
- Reducing environmental impact (greening the school)
- Showcasing opportunities

Benefits

- Economic
  - ✓ Lower energy bills (usage and demand)
  - ✓ Lower operating and maintenance (O&M) costs
- Improve teaching environment
- Improve comfort level
- Reduce environmental impact
- Develop benchmarks
  - ✓ Energy ($/student, $/ft^2)
  - ✓ Demand (kw/mo)

Getting Started

- Determine a "baseline" of energy usage for all facilities
  - ✓ Identify high usage facilities
    - Electricity, natural gas, water
  - ✓ Identify energy saving opportunities for these facilities
  - ✓ Develop and continue to track energy benchmarks
    - Costs ($/student, $/ft^2)
    - Energy (kBtu/ft^2, kBtu/student)
    - Demand (kW/mo)

Conduct an Energy Efficiency (E2) Audit

- ❑ Identify and form an E2 audit team
- ❑ Gather pre-assessment information
- ❑ Conduct on-site school visit
- ❑ Identify energy conservation measures (ECMs)
  - ✓ Include both energy and cost savings
- ❑ Determine if ECMs are economically feasible

Who's on the E2 Audit Team?

- School Personnel
  - ✓Energy manager
  - ✓Principal
  - ✓Maintenance/custodian
  - ✓Billing/accounting
  - ✓Teachers
  - ✓Students
- Equipment Vendors and Suppliers
- Technical Assistance Provider or Consultant

Gather Pre-Assessment Info

- **Facility data**
  - ✓ **Basic site information**
    - **Address, main contacts, phone numbers**
  - ✓ **Lighting, HVAC, and plug load equipment inventories, if available**
  - ✓ **12 months of energy bills (gas, electric, propane, etc.)**
    - **Usage and demand**
    - **Rates**
  - ✓ **Building layout**

On-Site School Visit

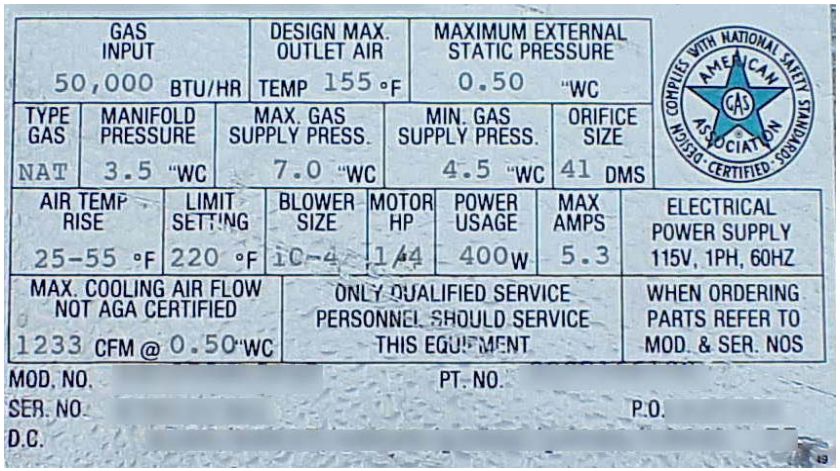
- Initial meeting
  - ✓ Confirm information, check provided documents
  - ✓ Confirm school priorities
- School tour
  - ✓ Take lots of notes
  - ✓ Talk to a cross-section of school personnel
  - ✓ Take pictures, if possible
- Closing meeting
  - ✓ Ask more questions, collect more data
  - ✓ Brainstorm for solutions to known issues
  - ✓ Make plans to further evaluate suspected issues

Confirm the Priorities

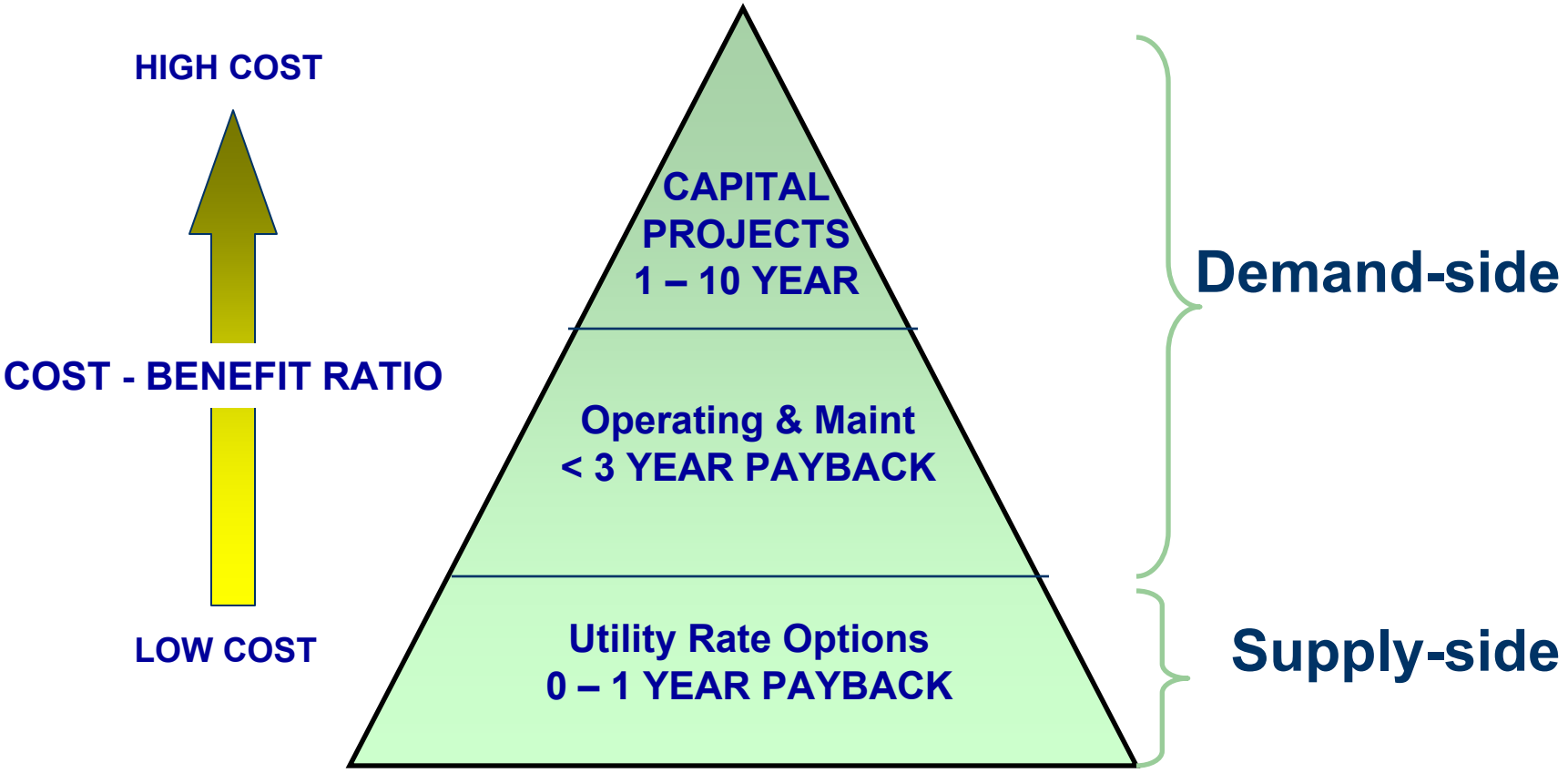
- Money?
- Comfort?
- Indoor air quality?
- Student performance?
- Opportunities to showcase?
- Reduce environmental impact?

Gather Site information

- Talk with school personnel to determine operating schedules and any known energy issues
- Conduct lighting, HVAC, and plug load equipment inventories, if not already completed
- Read equipment nameplates



Prioritize Appropriately



Move up the opportunity hierarchy!

Identifying Energy Management Opportunities

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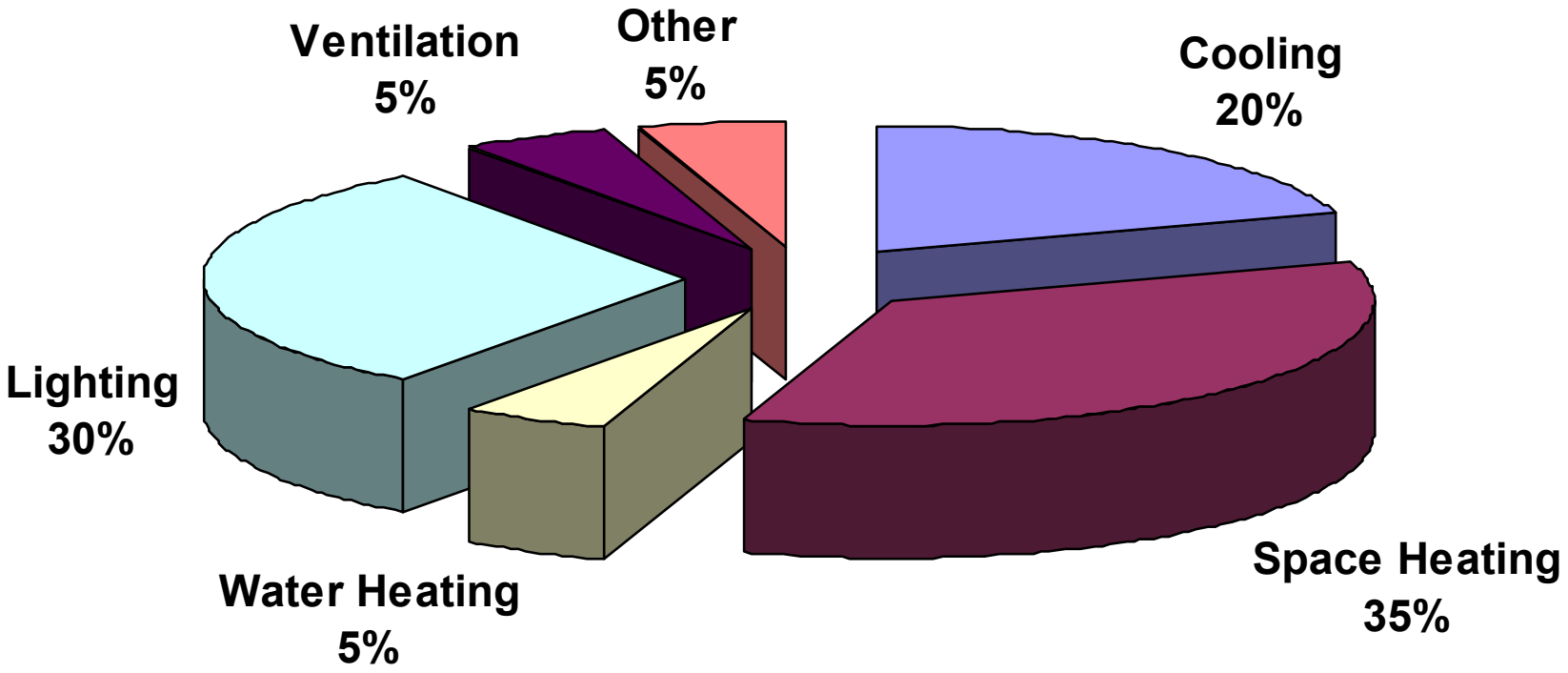
Identifying Energy Opportunities

Do you start here?

Or here?

Or here?

Typical School Energy Use Breakdown



Typical Savings Potential: 10-15%

Can Be As High As 30%

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Energy Opportunities

- **No Cost**
  - ✓ Incidental activities
  - ✓ No purchases required
  - ✓ Minimal labor required
- **Low Cost**
  - ✓ Purchases within existing O&M budget
  - ✓ Some dedicated labor needed
- **Capital Cost**
  - ✓ Sometimes it takes money to save money

Energy Opportunity Categories

- Programmatic
- HVAC
- Lighting
- Plug Loads
- Building Envelope
- Maintenance

No-Cost Energy Opportunities (Typical Savings)

- ❑ Establish and communicate a policy (1-3%)
- ❑ Benchmark your school (1-3%)
- ❑ Assign responsibility for common areas (1-3%)
- ❑ Establish a recognition program (1-2%)
- ❑ Control classroom thermostats (1- 5.5%)
- ❑ Use a building automation system (1- 4%)
- ❑ Turn off outside lighting (1-2.5%)
- ❑ Establish a plug load plan (1-2%)
- ❑ Keep doors & windows closed (1-2%)
- ❑ Control exhaust fans (1-2%)

Establish and Communicate a Policy

- Connect it to the business plan
- Roles and responsibilities
- Temperature set points
- Computer use (school & personal)
- Vacation shutdown guidance
- Benchmarking
- Awareness and training
- Energy efficiency committee

Establish and Communicate a Policy/Plan

- **Objective**
  - ✓ Bullitt County Public Schools is committed to promote energy efficiency to our faculty, staff, students and community.
  - ✓ We shall strive to conserve energy and improve the energy efficiency of our buildings, vehicles, and equipment and the goods and services that we use. We shall use environmentally safe and sustainable energy sources as often as practical while achieving savings. We shall strive to increase our use of energy from renewable sources.
  - ✓ We shall implement these principles by demonstrating community leadership, collaborative planning and by adopting best energy management practices. We shall establish goals, objectives and indicators; conduct an annual self-evaluation of our progress; and communicate regularly with the Bullitt County Public School.
- **Responsibilities…**
- **Guidelines….**

Benchmark Your School

- Portfolio Manager
- Energy Watchdog
- School Dude
- Advantage IQ
- MS Excel

Assign Responsibility for Common Areas

- ❑ Hallways
- ❑ Multi-purpose rooms
- ❑ Cafeterias
- ❑ Auditoriums
- ❑ Restrooms
- ❑ Gymnasiums
- ❑ Locker rooms
- ❑ Meeting areas
- ❑ Stage
- ❑ Storage areas

Valley Elementary School Common Areas Checklist	
Space:	Cafeteria
Monitor:	Ms. Jones
X	Lights
X	Doors/Windows
N/A	Computers
X	Temperature Settings
N/A	Water Fixtures
N/A	Exhaust Fans
Notes:	

Establish a Recognition Program

- Appreciation for ideas and hard work
- Award ceremonies for visibility
- Recognition at staff/faculty meetings
- Everyone begins to see E2 as a priority

Control Thermostats

- **Manual**
  - ✓ Set for comfort during class
  - ✓ Establish temperature range (i.e. 72-78°F)
  - ✓ Set back nights & weekends
    - About 8-10 degree setback
- **Programmable**
  - ✓ Establish range
  - ✓ Periodically inspect settings
  - ✓ Beware of overrides

Every 1°F ≈ 1% Savings

Use a Building Automation System (BAS)

- Optimize system Settings
  - ✓ Requires a technician
- Can be impacted by Off-schedule events

Turn Off Outside Lighting

- Purposes of outside lighting
  - ✓ Staff safety
  - ✓ Crime prevention
  - ✓ Extra-curricular activities
- According to national crime prevention council
  - ✓ A dark campus seems to deter vandals
  - ✓ Incidence of theft is unaffected by lights on/off

Establish a Plug Load Plan

- PC power settings
- PC security patch management
- Vending machine power control
- Standby power
  - ✓ Use of power strips
  - ✓ Unplug if not using
  - ✓ Office equipment
  - ✓ ENERGY STAR rated
- Seasonal shutdown
- Refrigerators
- Kitchen equipment
- Water heaters

ENERGY STAR PARTNER

Keep Doors & Windows Closed

- Minimize building envelope penetrations
- Schools usually set up for positive pressure
  - ✓ If window is open, conditioned air is wasted by venting to the outside
- Inspect outside air dampers
  - ✓ They can get stuck in the open position

Control Exhaust Fans

- **If the school's ventilation system is off, the exhaust fans can create negative air pressure**
  - ✓ **Outside air seeps in through openings in the building envelope and brings in air that affects building temperature and humidity**

Low-Cost Energy Opportunities

- Adopt a vacation shutdown program (1-5%)
- Obtain and analyze load profiles (1-5%)
- Perform energy audits (1-15%)
- Provide energy efficiency training (1-3%)
- Install programmable thermostats (1-10%)
- Install 365-day time clocks for outside lights not on BAS (1-2%)
- Start a program to replace exit signs with LEDs (1-2%)
- Install lighting timers or occupancy sensors (1-2%)
- Ensure key maintenance activities are performed (1-4%)
- Inspect all outside air systems (1-2%)

Adopt a Vacation Shutdown Program

- Look for opportunities to shutdown equipment
- Assign responsibility

VACATION PERIOD SHUTDOWN SCHEDULE

	Long Weekends	Winter	Spring	Summer
Thermostats - Heat:	by season	50-55°F	Off	Off
Thermostats - Cool:	by season	Off	Off	80-85°F
Computers	✓	✓	✓	✓
Vending Machines	✓	✓	✓	✓
Refrigerators		✓		✓
Water Heaters	✓	✓	✓	✓
Water Fountains				✓
Exterior Lighting	✓	✓	✓	✓
Kitchen Equipment	✓	✓	✓	✓
Computer Lab	✓	✓	✓	✓
Other Plug Loads	✓	✓	✓	✓

Obtain And Analyze Load Profiles

- Benchmark all schools first
- Select high energy-consuming schools (kBtu/ft, kWh/student, etc.)
- Request a load profile from utility company
  - ✓ You can also build a load profile if they only will give you the raw interval data
- Analyze power demand patterns
- Look for load-shedding and/or load-shifting opportunities

Perform Energy Audits

- Benchmark all schools first
- Select high energy-consuming schools (kBtu/ft, kWh/student, etc.)
- Review data to target audit sites
- Perform a walk-through audit

Provide Energy Efficiency Training

- Types of Training
- Awareness – policies, practices, projects, general concepts
- Education – methods, techniques, procedures, technical concepts
- Job-specific technical – maintenance, custodians, food service, admin, teachers, non-instructional staff
- Task-specific technical – designated person, checklist, specific instructions, schedule

Install Programmable Thermostats

- Identify good candidate areas
  - ✓ Common areas
  - ✓ Classrooms
- Check for compatability with HVAC system
- Ensure optimal settings, setbacks, and time scheduling
- Consider reasonable overrides

Install Timers For Outside Lighting

- Evaluate purposes for outside lights
  - ✓ Staff safety
  - ✓ Crime prevention
  - ✓ Extra-curricular activities
- Programmable for an entire year
  - ✓ But clocks may run slow or fast after awhile
- Autosensors available for daylight
- Automatic daylight savings adjustment
- Find the circuits
  - ✓ Possible candidates include parking lots, walkways, entrances, exterior walls, interior campus areas, outdoor recreational areas

Replace Exit Signs With LED

- Can be done with in-house maintenance staff
- Add to your Preventative Maintenance program
- Can be done in conjunction with retrofit projects
- Life cycle is more than 200,000 hours
- You probably have more than you think, and the savings are 24/365

Install Timers and Occupancy Sensors

- Vending machines have a captive audience
  - ✓ Why light them?
- Lighting occupancy sensors

Application	Energy Savings
Offices (Private)	25-50%
Offices (Open Spaces)	20-25%
Rest Rooms	30-75%
Corridors	30-40%
Storage Areas	45-65%
Meeting Rooms	45-65%
Conference Rooms	45-65%
Warehouses	50-75%

Ensure Key Maintenance Activities Are Performed

- Filter changing
- Fan belt replacements
- Coil cleaning
- AC condensation drip pans
- Duct leak prevention
- Boiler system maintenance
  - ✓ Air/fuel mixture
  - ✓ Condensate recovery
  - ✓ Pipe insulation
  - ✓ Steam traps

Inspect All Outside Air Systems

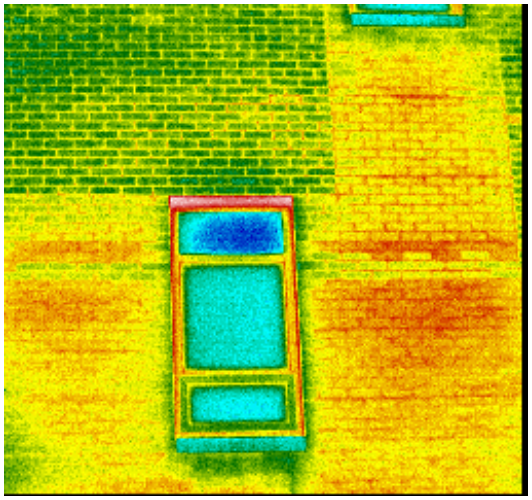
- Check for optimal settings
  - ✓ Thermostats
  - ✓ Humidistats
  - ✓ CO2 sensors
- Make sure everything is clean and unblocked
- Check for proper operation
  - ✓ Economizers
  - ✓ Dampers

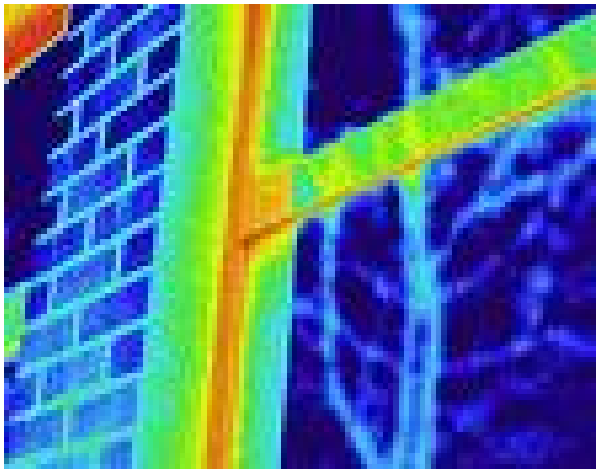
Capital Project Energy Opportunities

- Use enhanced auditing tools (1-3%)
- Implement a behavioral modification program (1-3%)
- Implement a monetary incentive program (1-3%)
- Install a building automation system (1-5%)
- Implement building commissioning (1-7%)
- Install mechanical system upgrades (1-4%)
- Upgrade lighting (1-8%)
- Building envelope projects (1-5%)
- Adopt a Preventative Maintenance program (1-6%)

Use Enhanced Auditing Tools

- Upgrades BAS to enable trending analysis
- Utility bill analysis
- Submetering
- Power monitoring
- Data loggers
- Infrared thermography
  - ✓ Roof & walls
  - ✓ HVAC ducts
  - ✓ Electrical system





Behavior Modification Program

- Awareness campaign – general concepts, facts & figures, visuals, slogans
  - ✓ Applies to everyone
- Training and education program – methods, procedures, technical concepts
  - ✓ More limited audience
- Management program – plan, assess, implement, monitor, reassess
  - ✓ Focused group
- If using outside assistance, evaluate fee-based vs. performance-based

Monetary Incentive Program

- Consider the behaviors you want to reinforce
- Keep the evaluation process simple
- Make sure people are engaged in the process
- Promote the results district-wide

Install a BAS

- IF properly installed, programmed, and maintained, can reduce energy use significantly
- Provides improved control of indoor air quality
- Can monitor: temperature, humidity, component on/off, damper positions, pressure, CO2, power
- Can control: system schedules, temperatures, set points, motors, dampers

Implement Building Commissioning

- Can cost from $25k - $85k, but still have paybacks of 1 - 3 years
- Can uncover multiple issues
  - ✓ Simultaneous heating and cooling
  - ✓ Defective or out-of-calibration sensors
  - ✓ BAS not programmed effectively
  - ✓ Operating systems not optimized
  - ✓ Owners operating requirements not followed
  - ✓ Set points incorrect or overlapping
  - ✓ Improper control of outside air
  - ✓ Building envelope failures
  - ✓ Space use changes

Install Mechanical System Upgrades

- System controls (occupancy, CO2, etc.)
- Variable Speed Drives (VSDs) for fans and pumps
- Upgraded AC systems
- Upgrade to properly sized, high-efficiency boiler
- Install a flue gas analyzer to adjust boiler mix ratio
- Repair leaking steam traps
- Install a heat recovery system

Upgrade Lighting

- T-12s to T-8s
  - ✓ About a 20% reduction in power requirements
- Incandescents to CFLs
- T-5 high-bay lighting (gymnasiums)
- Lighting controls
- Induction lighting
- LED

Building Envelope Projects

- Outside air dampers
- Cool roofs
- Solar tube daylighting
- Window films
- Insulation repairs/upgrades
- Air duct sealing/insulation

Due to possibly longer payback periods, consider bundling these with other projects

Adopt a Preventative Maintenance (PM) Program

- Move beyond reactive and routine maintenance
- PM program components
  - ✓ Overview – objectives, cost, benefits
  - ✓ Systems and equipment inventory
  - ✓ Inspection program – evaluate physical and functional conditions, note optimization needs
  - ✓ PM schedule
  - ✓ Hazard awareness
  - ✓ Standard operating process for work orders

Energy Opportunity Categories

- Programmatic

People Side

- HVAC
- Lighting
- Plug Loads
- Building Envelope
- Maintenance

Technical Side

Financing Options

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How Do You Pay For It?

- Performance Contract
- Tax-exempt lease-purchase agreement
- Bonds
- Tax Increase
- Cash

What is Performance Contracting?

- A ***process*** where a customer ***partners*** with a ***qualified*** service provider
- Together they develop a program consisting of ***financial***, ***technological*** and ***operational*** solutions that meet specific ***performance criteria***
- The financial risk lies with the service provider who guarantees the customer ***a required level of performance***
- May be secured with a performance bond, reserve fund, or strong balance sheet

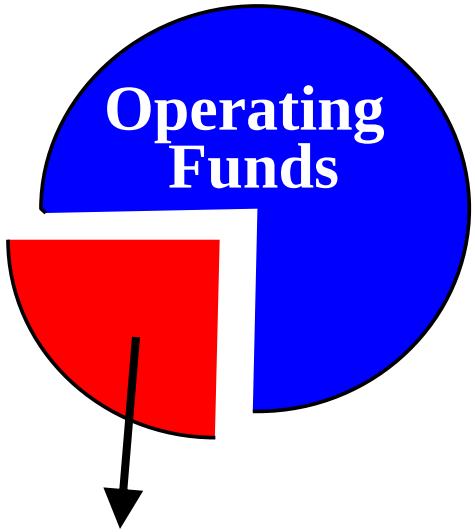
Suitable Types of Projects

- HVAC - entire systems, boilers, chillers, conversions, etc.
- Lighting - upgrade to efficient lighting, increase light levels
- BAS - control your environment, integrate security and fire
- Building envelope-doors, windows, insulation
- Water and wastewater projects

Where the Money Goes

Before Contract

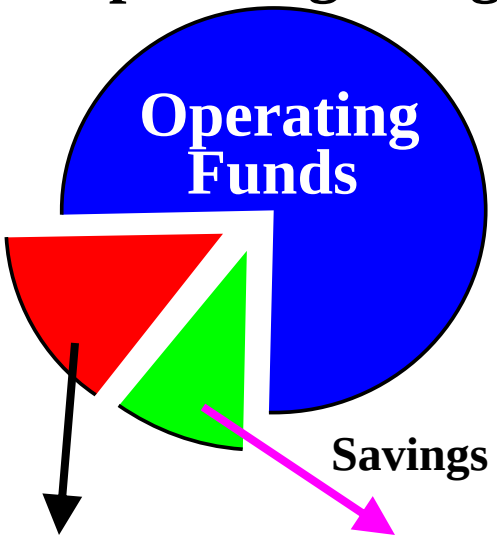
Operating Budget



Utility Budget
-Lights
-Air Conditioning
-Heating

During Contract

Operating Budget

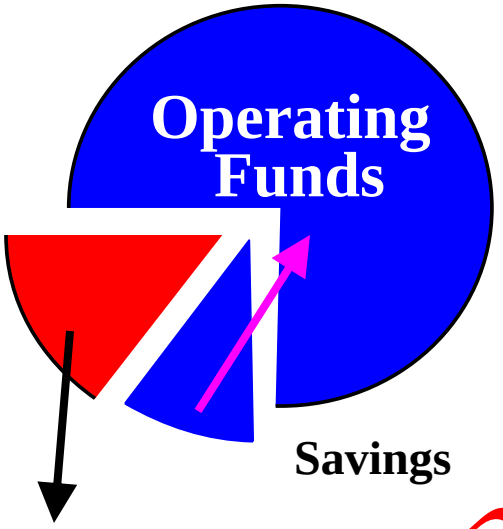


Utility Budget
-Lights
-Air Conditioning
-Heating

Investment
-Modernization
-Energy Retrofits

After Contract

Operating Budget



Utility Budget
-Lights
-Air Conditioning
-Heating

Investment
-Modernization
-Energy Retrofits

PAID

Tax-Exempt Lease-Purchase Agreement

A.k.a. Municipal Lease

- **Acts like an installment purchase plan**
- **Exempt from federal income tax**
- **Paid out of existing budget for line-item utility expenses**
- **Non-appropriation language**
  - ✓ **Not considered "legal" debt, therefore voter approval usually not needed**
  - ✓ **May count as debt for credit rating purposes (Moody, Standard & Poor)**

Bonds

- Usually have low interest rate
- Available at the district level
- May include costs for
  - ✓ Compensating underwriters
  - ✓ Paying for financial advisors
  - ✓ Obtaining legal opinions
  - ✓ Obtaining credit ratings
  - ✓ Educating voters on bond referendums
- However, bonds are usually the lowest-cost option for Kentucky schools due to provisions for recurring funds
- Consider performance contract or municipal lease if bonding capacity is low

New Federal Stimulus Bond Program

As proposed in Federal House bill

- State & local governments can issue "qualified school construction bonds"
  - ✓ $11 billion for 2010
  - ✓ $11 billion for 2011
- Designed to make school bonds more attractive to investors, lowering the school's interest, and making construction projects more affordable
- Bond funds can be used for construction, rehabilitation, repair, of a public school, or purchasing land to build a school

Tax Increase

- Property or utility tax increase is usually a hard sell
- Minimum of $0.30/$100 assessed value for property tax, but some locations as high as $1.00/$100
- 4% of school revenue from property tax is the maximum allowed
- Utility tax of up to 3% already in place in many districts

Cash

- From existing budget
- Internal approval process
- Fast
- Usually not enough of it to go around

Funding Mechanisms Summary

	CASH	BONDS	TAX-EXEMPT LEASE	PERFORMANCE CONTRACTS
Interest Rates	N/A	Lowest tax-exempt rate	Low tax-exempt rate	Taxable or tax-exempt
Financing Term	N/A	May be >20 yrs	<10 yrs common, up to 15 yrs for large projects	<10 yrs common, but up to 15 yrs possible
Other Costs	N/A	Underwriting, legal opinion, insurance, etc.	None	May have to pay engineering costs if contract not executed
Approval Process	Internal	Possible taxpayer approval/ public referendum. Bond counsel opinion letter required	Internal approvals needed; simple attorney letter required	RFP usually required; internal approvals needed
Approval Time	Current	Process may take years	Fast; generally < week of receiving all documentation	Fast; similar to the Tax-Exempt Lease
Funding Flexibility	N/A	Very difficult to go above the dollar ceiling	Can set up a Master lease, which allows you to draw down funds as needed	Relatively flexible; an underlying Municipal Lease is often used
Budget Used	Either	Capital	Operating	Operating or Capital
Largest Benefit	Direct access *if* included in budget	Low interest rate because it is backed by the public entity	Allows you to buy capital equipment using operating dollars	Provides performance guarantees which help approval process
Largest Hurdle	Never seems to be enough project money	Very time consuming	Identifying the project to be financed	Identifying the project to be financed, selecting the ESCO

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